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PNEUMATIC GUN CARRIAGE AT SANDY HOOK.

The modern gun, whether it be of the sea coast type, barbette, or flank defense, is so much larger and heavier than the old style—carries such a charge of powder and gives such an increased shock in recoil—that the construction of the carriage which must bear its weight and withstand its recoil is of more than ordinary importance. Perhaps it would not be an exaggeration to say that, in building a new fleet, the selection of an efficient gun carriage for its battery is quite as vital to success as the selection of a trusty gun; and as the aggressiveness of fighting ships is in a direct ratio with the effectiveness of their batteries, it follows that defective carriages may render impotent the best efforts of the naval designer.

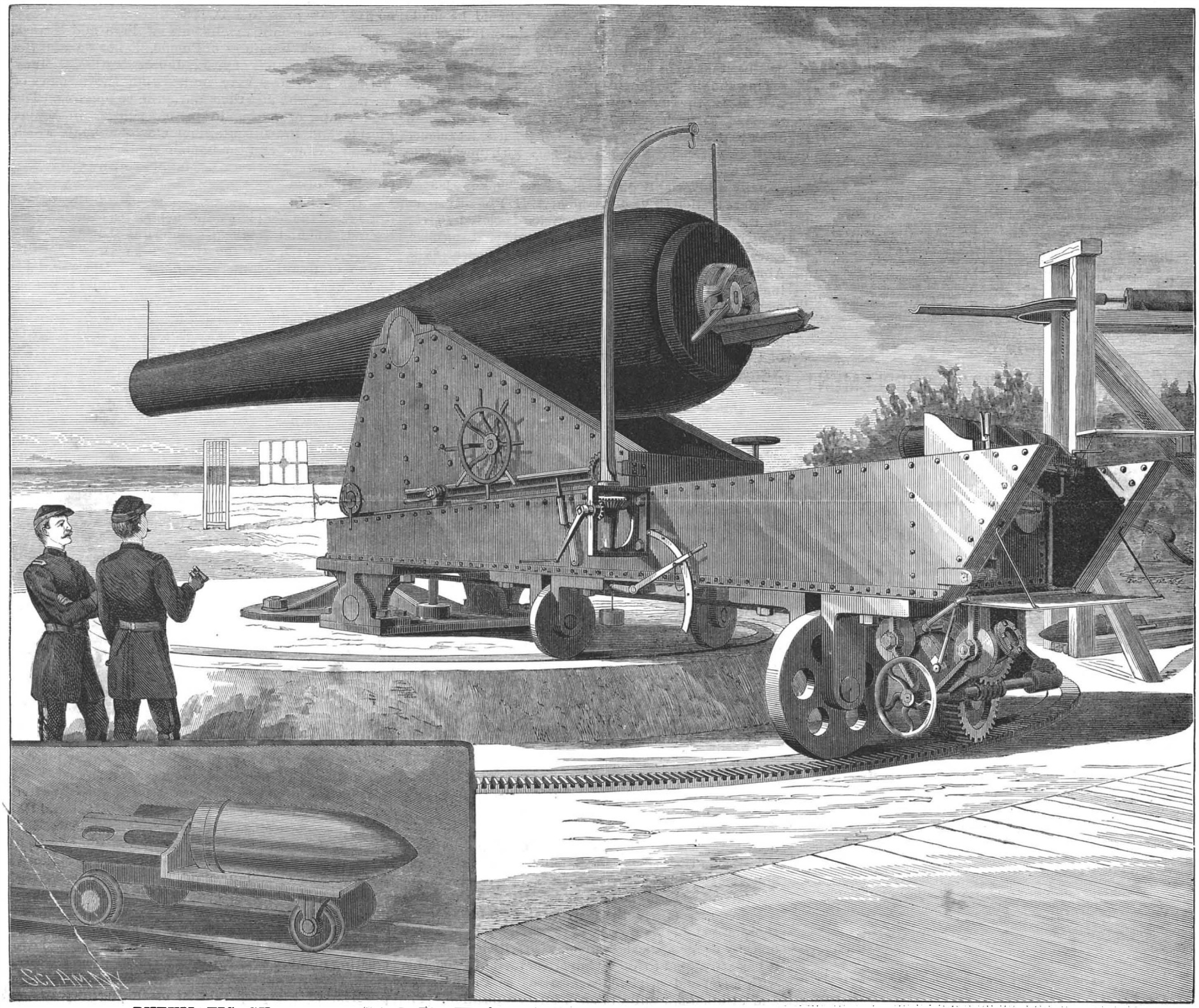
In a recent number we illustrated the hydraulic gun carriage, taking as an example one of those designed for the Atlanta's 8 inch breech loading rifles. In this number we illustrate the pneumatic carriage at Sandy Hook with gun in rest. These two types are, by long odds, the best yet devised, and each has such merit that the first authorities of the day are divided in opinion as to which deserves the first place.

Strength, as may easily be imagined, is the first requisite in a carriage for heavy guns; ability to withstand the shock of recoil being the test of efficiency. It must also be easy to maneuver, because a gun that cannot be readily trained and sighted, however ponderous and potent its projectile, loses much of its effectiveness. Toothed gear is now generally used in elevating and depressing the gun and in the lateral movements. The pneumatic carriage, like its hydraulic prototype, automatically returns the gun to battery after firing. It receives and counteracts the force of the recoil wholly within itself. It may be said for the pneumatic type that it is simpler in construction than the hydraulic, fixes more accurately the power of the gun in recoil, and hence returns it sooner to battery. Water can be used as a recoil check of a hydraulic carriage only in certain seasons, and other liquids are apt to cake and cloy in the cylinders and lead to mishaps, whereas in the use of an elastic gas, as in the pneumatic carriage, there is no fear of this.

Let us turn for a moment to the Westinghouse air brake, which resembles not a little the pneumatic gun carriage. For many years its designer essayed unsuccessfully to bring about its adoption. Eminent engineers insisted that it was not a practicable contrivance for stopping trains of cars. It was constructed, they averred, upon a misconception of natural laws, and while carefully watched by interested persons on a trial trip where danger did not menace, it was faulty in design and uncertain of action, and they prophesied that when the vital moment came when its repressive action was most desired, it would prove wholly inadequate and fail lamentably. We have seen that they were mistaken in this, for to-day it is in almost universal use, its power being so well adjusted, and so certain withal, that a single man, by pressing a simple lever to the right or left, can, in a few moments, bring the heaviest train to a complete stop. The pneumatic gun carriage at Sandy Hook, which we illustrate, is constructed after the famous Powlett design. It is worked by compressed air, which comes from a pipe connected with the breast of the carriage. By means of simple levers, this air, besides being used to check the force of the gun in recoiling after firing, can be made to train the gun, elevate and depress it, and move it quickly from side to side. The old style carronade and broadside gun, pygmies in comparison, could not be handled by their numerous crews more readily than the great modern gun weighing many tons can be worked by means of this really simple apparatus.

The Sandy Hook pneumatic gun carriage has a slide furnished with cross transoms and angle knees sufficiently strong to bear the running and recoil cylinders. The latter are lodged beneath the piece and between the slide rails, care being taken to prevent their destruction by hostile shot. Inside one of the slide rails there is rack piece with a rolling eccentric clutch, fur-

(*Continued on p.* 120.)



PNEUMATIC GUN CARRIAGE USED WITH THE TRIALS OF HEAVY ORDNANCE AT SANDY HOOK, N. J.

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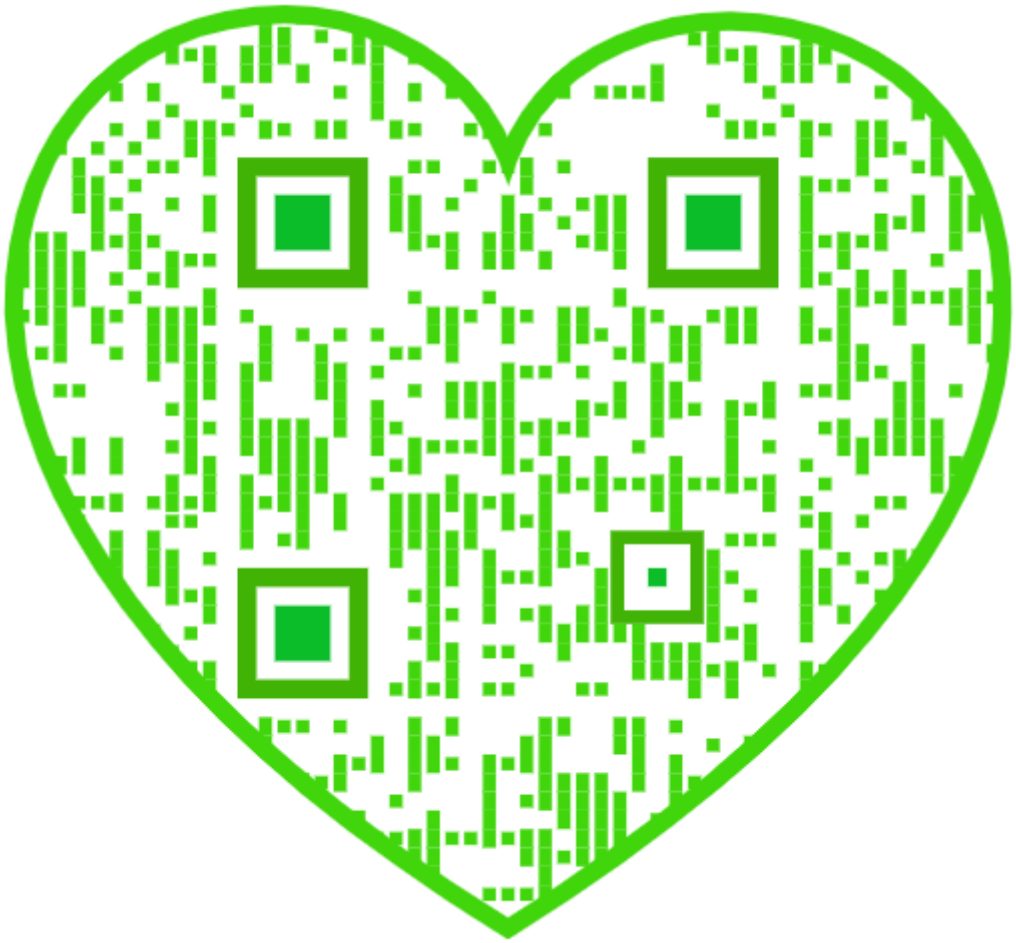

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NEW YORK, SATURDAY, AUGUST 20, 1887.

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THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

Two main ends are accomplished by this association, which has just held its thirty-sixth annual meeting, in Columbia College, in this city. One of these is the interchange of scientific views and consequent increase of knowledge, the other is the social intercourse of scientific people. For both these objects favorable arrangements had been made by the citizens of New York, in expectation of an unusually large attendance. The roll of members, active and associate, showed 564 names up to Friday morning, of which 273 were those of new members. While this list has been surpassed at several former meetings, it should be understood that the rules are more strict than heretofore, especially as to associate members.

The opening meeting on Wednesday morning was called to order by Prof. E. S. Morse, the retiring president, who surrendered his chair to Prof. S. P. Langley, of Washington, D. C., the president-elect. After a prayer by Bishop Potter, Pres. Barnard, of Columbia College, made an address of welcome in the name of the city of New York, reviewing the achievements of the association during the forty years of its career, and paying a fitting tribute to those members whose labors were done and who had gone to their rest. Pres. Langley made an appropriate reply, after which the association transacted the routine business incident to the full organization of the several sections. A number of important changes were made in the constitution, at the recommendation of the standing committee, which is to be hereafter called "the council."

The addresses of the vice-presidents before the sections occupied the entire afternoon. The following is a brief report of these addresses.

Section B was addressed by Prof. W. A. Anthony, of Ithaca, on "The Importance of the Teaching of Physics in the Public Schools." He deplored the prevalent utilitarianism that demanded a commercial value for all scientific work. It is time to reverse this demand and to call for a process by which commerce shall contribute to science. As our nation grows in wealth, the principles and details of science should be made common property, and become the daily talk of the school boys. The precious truths of nature are the best heritage to be left to future generations. Physical science should be taught in the primary schools as well as in the universities. Thus an army will be raised up to push scientific work into new fields. In order to promote the application of science, let science itself be fostered. New experiments with new instruments will be sure to reach remunerative results, especially if invariably directed by scientific knowledge.

Before section C, Vice-President A. H. Prescott spoke on the "Chemistry of Nitrogen as disclosed in the Constitution of the Alkaloids." He said that the character of nitrogen is a challenge to chemical skill. Abundant in its free state, its compounds are so sparingly obtained that they set the values for the nourishment of life. Nitrogen is trusted for the projectile arts of war and peace, holds the structure of the aniline dyes, and governs the vegetable alkaloids. The study of the structural chemistry of the latter includes: 1. Nitrogenous bases as derivatives of ammonia. 2. As represented by aniline. 3. The pyridine type in the vegetable alkaloids. It may yet come to pass that the identical alkaloids of nature will be made by art. This will not be done by chance methods nor premature short cuts, but by well-earned progress through scientific methods faithfully applied.

Hon. Eckley B. Coxe, vice-president of section D, spoke on "The Necessity of Scientific Training for Engineers." An occasion like the present, when an engineer who is really a business man is called upon to preside over a scientific body, naturally gives food for reflection. Engineering, though the youngest of the professions, is already divided into civil, mining, mechanical, and other branches. The engineer is deeply indebted to those who have determined experimentally and discussed mathematically the data which are indispensable to him. The great success of the first practical engineers, who were developed in the field or in the workshop, was achieved in spite of—not on account of—their lack of scientific education. There are three classes of engineers—scientific, consulting, and business. A young man should decide which of these he wishes to become, and adapt his studies accordingly. There is as much need of a technical education for the engineer as there is for the lawyer, physician, or clergyman.

The admirable address by Prof. Gilbert, before section E, concerning the "Work of the International Congress of Geologists," attracted so much attention, and awoke so great an interest, as to be made the special subject for general discussion for the whole session on Friday, in the geological section. It was a thorough and able review of what has already been done by the geological congress, with criticisms on what it has attempted to do by imperfect methods, together with novel and original suggestions as to the scope and attainable results of such an organization. The address was quite lengthy, and instead of attempting a synopsis here, the reader is referred to the full report of it in the SCIENTIFIC AMERICAN SUPPLEMENT for this week.

Prof. W. G. Farlow, of Cambridge, addressed Section F on the subject of "Vegetable Parasities and Evolution."

A parasitic plant is one obliged to obtain its organized material from other plants or from animals. Parasites subsisting on dead matter are called saprophytes; those on living substances, true parasites. Mould on bread is a saprophyte; the potato rot fungus, a true parasite. Most parasites belong to the fungi. It is highly probable that vegetable parasites originated from non-parasitic forms. There is reason for believing that the earliest forms of undoubted plants were unicellular and not unlike protococcus. As soon as a protococcus has developed the power of attaching itself to other protococci, lost its chlorophyl, and developed means of penetrating the wall of its host, it has assumed all the essentials of a chytridium. The development of the filamentous and higher parasites from such chytridiaceous forms is possible. When one regards fungi as a single class of plants, and attempts to trace a clear connection between the highest and lowest members, he finds numerous gaps that cannot well be filled. A general parallel, however, exists between the fungi and the chlorophyl-bearing algæ, and the development may have been from the lowest to the highest algæ, and the different groups of fungi may have arisen from different groups of algæ at different periods in the process of evolution.

Address by Professor D. G. Brinton, of the University of Pennsylvania, before the anthropological section, H: "A Review of the Data for the Prehistoric Chronology of America."

Humboldt's hesitancy as to the origin of the human race should disappear, at least so far as the American Indians are concerned. The sources of information are: 1. Legendary. 2. Monumental. 3. Industrial. 4. Linguistic. 5. Physical. 6. Geological.

1. Back of the fifth generation all becomes vague and mythical, and all verbal records are apt to be untrustworthy. Even in the annals of Mexico there is no fixed date prior to A.D. 1325.

2. The stone-built monuments of Peru and Mexico, and the brick buildings of Pueblo, do not warrant the claims for thousands of years—hundreds will do. Many of these structures were built within the memory of the natives, who met their European conquerors. The shell heaps, or refuse heaps, of villages in Maine, Florida, and Brazil contain remains of animals which are now extinct, and the human skulls found are of a different race. That race was familiar with pottery and polished stones.

3. In the oldest relics we find proofs of the palæolithic age—the simplest implements. In other ancient mounds we find fragments showing that the tribes were acquainted with the compound arts. The cultivation of useful plants is important. Maize and tobacco were raised over an area of 5,000 miles in diameter.

4. The exceeding diversity of dialects in America proves high antiquity, but the many incorporative traits show original identity of plan.

5. Physical research is hindered by ideas of race classification. Maylayans and Americans were wrongly classified by Cuvier as Mongolians. The most ancient American skulls prove that in craniological features the American race in time and distribution has been identically one.

6. Man lived in North and South America immediately after the glacial epoch, but the epochs in the two continents may not have been synchronous. The American could not have immigrated from Africa or Asia, though the first American man was an immigrant and not autochthonous. When geology and geography have been studied more thoroughly in their application to anthropology, the lines of migration may be traced.

Prof. H. E. Alvord, Vice-President of Section I, spoke upon "Economy in the Management of the Soil."

Tracing the visible wealth of the country to its source, we find that it has all, with insignificant exceptions, been derived from the soil. Generation after generation has recklessly drawn on the stored fertility of the soil with no systematic effort at restitution. For food, clothing, shelter, and fuel, we depend almost entirely upon the soil. In spite of the rapidly increasing demands of our own country, for twenty years agricultural products have constituted three-quarters of all the exports from the United States; and this superabundance of soil products will continue well into the next century. Every crop removed diminishes its store of plant food, and this reduces its reproductive power. The most important elements of plant food are potash, phosphoric acid, and nitrogen. Much remains upon or is returned to the land, but there is great waste in addition to what is sent abroad. The revival of interest in agricultural studies, and the increasing number of able men who make them their life work, promise some success in the efforts to solve the problem of the perpetuation of the fertility of our soil.

The address of Professor E. S. Morse, the retiring

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president of the association, was delivered on Wednesday night, in the library hall, before a large and appreciative audience. His subject was "A Decade of Evolution," and he reviewed with great earnestness and enthusiasm the work that had been done in the last ten years, especially by American naturalists, to prove and illustrate the Darwinian theory of the derivation of species. The address abounded in facts of the most curious and instructive nature, and was well received, except that the speaker felt impelled to retaliate on the church for its alleged obstruction of the progress of modern science. The entire speech will be printed in the proceedings of the association, and will have a high degree of value as a contribution to the history of scientific progress. Next week we shall give an outline of the more important work done in the various sections.

It should be added that the members of the association, while fairly diligent in their allotted duties as scientists, availed themselves of the privileges of the metropolis and enjoyed a reasonable amount of sight-seeing. The excursions around the harbor and to West Point and Long Branch are popular features. The general reception on Thursday evening at the Metropolitan Opera House was a brilliant affair, and brought together a delightful company representing all parts of the nation.

REVIVAL OF PATENT EXTENSIONS.

The last Congress may be said to have revived the almost obsolete custom of extending patents beyond the original time for which they were granted, and the probability is that the Congress which meets in December next will be strongly urged to pass a new general law upon the subject.

By the amendment of the patent law passed March 2, 1861, the term for which letters patent are granted was changed from fourteen years to seventeen years, and the provision of the statute for the extension of patents was altogether struck out, the additional period of three years on the original term being held to be tantamount to an extension of all new patents for that much time. Patents granted subsequent to March 2, 1861, were issued without any privilege of extension, and the only way in which they can be lengthened is by a special act of Congress in each individual case. Hundreds of applications for extensions have been made to the Congressional committees, but, except in two or three cases, they have always been refused, and it had come to be generally understood by patentees that there was little or no chance of getting a Congressional extension. But Mrs. Henrietta H. Cole, of New York, inventor of the fluting machine patented June 12, 1866—twenty-one years ago—has been more fortunate. The last Congress granted her petition, authorizing an extension. The Commissioner of Patents has heard the required evidence, and has granted the extended patent. So this patent monopoly, after having expired and become free to the public for four years, is again revived and put in force for seven years, dating from June 12, 1883, the date of the expiration of the first term of the patent.

The grant of this extension will be a justifiable encouragement for all patentees whose patents already have or are about to expire to besiege Congress for special acts of relief in each particular case; and we hope no one will hesitate or be backward in filing their applications. There are undoubtedly many cases involving the greatest hardship to the inventor, in which an extension would be a relief. There are many inventions, of most extraordinary value, for which the inventors have not received a tithe of reward as compared with the benefits their devices have conferred upon the nation. Congress should either hear and determine each individual petition, and grant it, if just; or it should pass a general law, under which all patents may be extended; or it should put a stop to the grant of any patent extensions.

Last year a bill was introduced, but failed to pass, providing for the extension of all expired patents, and this, under proper conditions, would seem to be the easiest and fairest way of disposing of the matter. But it must not be forgotten members of Congress are politicians, and many of them seem rather to like to have their constituents run to them with their little private bills, as in that way a certain home influence and power is secured.

At present, the way to proceed for any one desiring to obtain an extension of a patent is to make application by petition to Congress, to be presented and pressed by the senators and members from the State in which the petitioner resides. No official fees are required to be paid. Personal interviewing of members to explain the particular merits of the case is often of great assistance, particularly so if the lobbyist be a woman. Tears and tresses are a power at the Capitol.

SUNFLOWERS are used in Wyoming Territory for fuel. The stalks when dry are as hard as maple-wood and make a hot fire, and the seed heads with the seeds in are said to burn better than the best hard coal. An acre of sunflowers will furnish fuel for one stove for a year.

A Great Bell for Cologne Cathedral.

An official notice has been published of the great bell for the Cathedral of Cologne, the solemn inauguration of which took place some days ago with great pomp. The bell weighs 27,000 kilos., or about 26 tons 13 cwt. The clapper alone weighs 800 kilos., or nearly 15¾ cwt. Its perpendicular height is almost 14½ feet; its diameter at the mouth nearly 11½ feet. Twenty-two cannons taken from the French were assigned by the Emperor William for its manufacture; 5,000 kilos. of tin were added. It was cast by Andreas Hamm, of Frankenthal, and 21,000 m. (£1,050) were paid for the casting. It will be known as the Kaiserglocke, or Emperor's bell; and as the two other large bells in the cathedral bear the epithets respectively of Pretiosa (precious) and Speciosa (beautiful), this one is styled Gloriosa. It bears above an inscription recording that "William, the most august Emperor of the Germans and King of the Prussians, mindful of the heavenly help granted to him whereby he conducted the late French war to a prosperous issue, and restored the German empire, caused cannons taken from the French to be devoted to founding a bell to be hung in the wonderful cathedral then approaching completion." A likeness of St. Peter, the name patron of the church, is on the side, beneath which is a quatrain in the style of the mediæval conceits, praying that, as devout hearts rise heavenward at hearing the sound of the bell, so may the doorkeeper of heaven open wide the gates of the celestial mansion. On the opposite side is inscribed a sestet in German, of which the translation is:

"I am called the emperor's bell;
I proclaim the emperor's honor;
On the holy watch tower I am placed.
I pray for the German empire,
That peace and protection
God may ever grant to it."

The bell was solemnly blessed in the cathedral by the Archbishop of Cologne, according to the elaborate ritual set out in the *Pontificale Romanum*. The ceremony was very long, many psalms being chanted by the clergy and choristers while the bell was being sprinkled with blessed water and anointed with chrism, and the portion of St. Luke, x. 38-42, was chanted by a deacon. Incense and myrrh were burnt within it, and many symbolical rites performed. The opinions of experts are divided as to whether the note which the bell sounds is C sharp or D.

A Million Dollar Diamond—the Largest Brilliant in the World.

A model of the Victoria, the Great White Diamond or the Imperial, has been sent to this city lately, and Mr. G. F. Kunz gives in *Science* the following:

Concerning its early history very little is known; in fact, where the stone was found is only a matter of conjecture—a remarkable circumstance when we consider that this is the largest brilliant in the world.

An explanation by a letter in the *London Times* was given, as follows: "That this stone was not found in English dominions at all, but in the neighboring Orange Free State; that it had been found by a boor on his farm, who, knowing it to be a diamond, but fearing being turned out of his farm by a mob, kept the secret a whole year, until a Mr. Allenberg of Port Elizabeth saw it, and forwarded it to London."

It is, however, believed that it was found by some one in one of the Kimberley mines, South Africa. The first intimation that any of the various mining companies had of its existence was when they heard of its safe arrival in London. It is generally supposed that in the month of June or July, 1884, the stone had been found by one of the suveillance officers of the Central Mining Company in the Kimberley mines. It being his duty to search others, he had the privilege of not being searched himself, and so the stone was passed through the searching house, and he was afterward supposed to have found means of communicating with four illicit diamond buyers. Owing to the stringency of the diamond laws of Griqualand West, the trading in rough diamonds is forbidden any one not owning one of the "patents" or "licenses," as they are called, costing £200 and a guarantee of £500. All purchases made by them must also be entered in a special registry, and are duly signed every week by the police authorities. £3,000 was the price paid to obtain the stone from the first possessor. To prepare themselves for the ordeal of transporting the stone out of the district, they assembled at night, commenced drinking, then gambling, and after a night's debauch two of the party lost their share in the big stone. The other two reached Cape Town in safety, where the diamond laws are not in force, and from a dealer there received £19,000 cash for their stone. An outward duty of one-half per cent is collected on all shipments of diamonds from Cape Colony; but this diamond is said to have been carried by one of the passengers of a mail steamer, and was hence undeclared. We next hear from it in London, causing considerable sensation at Hatton Garden, the great diamond market. After considerable time had been spent in trying to find a capitalist who could afford to buy such a gem, it was at last arranged by a former resident of the Cape mines to form a company of eight persons, who bought the stone together for £45,000 cash, on condition that if they should dispose of it each should receive a ninth share in the eventual profits.

Before cutting, it was estimated that the crystal would furnish either of the following gems: If cut as a briallette, 300 carats; as a drop, 230 to 240 carats; as a lozenge, 250 carats; and as a mathematically perfect brilliant, 150 carats. If cut in the latter form, it would have furnished cleavages that would cut into one 40 carat, one 20 carat stone, and 40 carats of smaller stones. It was finally decided to cut it into the largest possible brilliant, still preserving a good shape, and Amsterdam was selected as the place where the gem could best be cut.

It was accordingly sent to the polishing mills of Jacques Metz, who erected a special workshop for the purpose. In order to better obtain the brilliant form of cutting, a piece was cleaved off which furnished a 19 carat diamond, and was sold to the King of Portugal for £4,000. The cutting of the large stone, which was commenced on the 9th of April, in the presence of the Queen of Holland, took about twelve months, since, instead of being cut by abrasion with another diamond, as diamonds are usually cut, it was polished down on the scaif; and a great amount of time was consumed by the cooling of the stone, as it heated after an hour's running on the wheel. The cutter of the stone was M. B. Barends. The stone in its finished condition weights 180 carats, and is a beautiful, perfect, steel blue diamond, and is the largest brilliant in the world.

It is 39·5 mm. (1 9-16 inches) long, 30 mm. (1 11-64 inches) wide, and 23 mm. (15-16 of an inch) thick, being exceeded in size by one diamond only, the Orloff, belonging to the Russian crown, which weighs 194¾ carats, but is a large deep rose, and not a brilliant. The Victoria exceeds the Regent in weight by 44⅛ carats. The Kohinoor weighs only 106 1-16 carats.

The form of the Imperial is not entirely even. On one side of the girdle there is quite a flat place, a natural unpolished surface, necessary, in cutting, to preserve the large weight of the stone. It is, however, a perfect 58 facet brilliant.

The original weight of the stone was 457½ carats, 3 1-60 ounces troy. The stone to-day is held by a London syndicate for £200,000.

Treatment of Dysentery.

In a correspondence from Bombay, Dr. C. MacDowall, physician in the British army of East India, speaks with great enthusiasm of the treatment of dysentery by *ipecacuanha*. Like other friends of this treatment, such as Docker, Ewart, Cunningham, Malun, etc., he says that it is *almost a specific*, renders the *disease easy to cure*, and *prevents the complication* most feared, *i. e.*, hepatic suppuration. But he emphasizes, particularly, that "the remedy be given early in the disease, at the proper time, and in the proper manner." The principles of the treatment are:

1. To give a *large dose* of ipecac, *at least* thirty grains for an adult.

2. To *prepare* the stomach to accept and retain such a large dose by about twenty drops of laudanum *an hour before* giving the ipecac; also the application of a sinapism over the stomach, and to administer the ipecac in the form of large *pills*, not in solution. It must also be given at *night*, at the time of going to sleep, *never in the morning*, and *not during the day*, and *no liquid* is to be taken after the dose has been given.

Sometimes the patient vomits a little mucus toward the morning hours, but the greater portion of the remedy has by that time been absorbed. This treatment must be renewed every night, and usually the improvement is marked by the third morning, or sooner; blood, mucus, pain, all three having disappeared. A disease which formerly made us despair now has lost its terror to us.

The opium may be substituted by a hypodermic injection of morphia. Bismuth subnitrat. may be given during the day. Small doses of ipecac are more than useless; they have been tried in India for over two centuries without lessening the mortality in dysentery. Since more than twenty years the above has been adopted as almost the only treatment in British India, and has given the best results.—*Progres Medical.*

Electric Meteorology.

Mr. G. A. Rowell, of Oxford, says the *Electrician*, sends us a pamphlet with the above title, in which he discusses the cause of the changes in magnetic declination. He adduces evidence to show that the European and American magnetic poles are coincident with the centers of greatest cold for the two continents. Hence he attributes the shifting of the magnetic poles to the same series of astronomic and geologic causes which produce the secular changes in climate. This theory leads to the uncomfortable conclusion that as the magnetic declination in this country continues to decrease, so our winters will increase in length and severity. Without laying undue stress on the point, the author is certainly able to appeal to our recent melancholy experiences as an argument upon his side.

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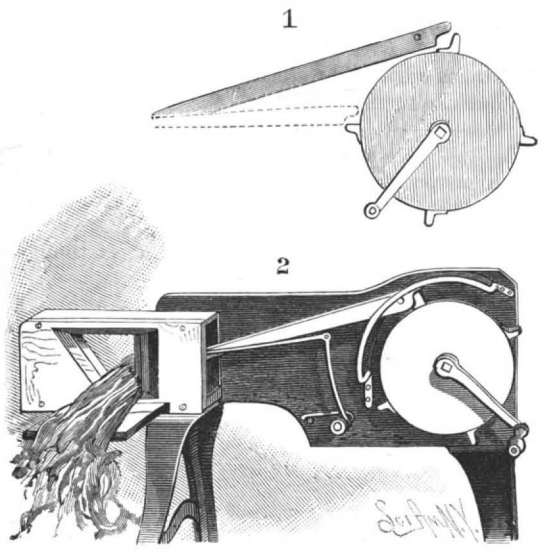
Railway Sand Blast.

The Hinckley Locomotive Works, of Boston, are building an express locomotive with a single pair of driving wheels. This engine is built to the order of a Boston syndicate, and is intended to run the fast express, the Flying Yankee, on the Boston & Maine. The engine will not be completed until Sept. 1. It is understood to embody many new features, and considerable interest will be felt in its performance. Any difficulty from slipping can probably be overcome by the use of the sand blast now successfully used on many English roads, and undergoing trial on the Chicago, Burlington & Quincy. The sand being thrown on the rail by a jet of compressed air, cannot be blown off before the wheel reaches it. Experience in England goes to prove that the success of engines with a single pair of drivers depends entirely upon the character of the sand supplied. If dry and delivered fairly on the rail close to the driving wheel tread, no time is lost from slipping, even where the tractive power of the engine is 94 lb. per lb. pressure on the pistons.

IMPROVED MECHANISM FOR RECIPROCATING PLUNGERS.

A novel means of imparting a reciprocating motion to a plunger, applicable for use in connection with a hay or vegetable cutter, or a hay press, or for other purposes, is shown in the accompanying illustration, and has been patented by Mr. George McCarn, of Goodland, Ind. The drum or disk, which may be operated by a crank arm or a sweep, has bosses or projections on its peripheral face, and a pitman, connected at one end to a plunger, is held against the peripheral face of the drum by circular guides, concentric with the axis of the drum. As the drum is revolved the pitman is forced to the position shown in dotted lines in Fig. 1, by one of the lugs upon the drum; and as the lug passes from engagement with the pitman, the latter is returned to its first position by



McCARN'S MECHANISM FOR RECIPROCATING PLUNGERS.

a spring and link. In Fig. 2 the plunger is represented as being provided with a knife, arranged to be thrown against the cutting edge of another knife carried by a casing, within which the plunger is mounted, as the invention may be utilized for cutting hay, roots, etc.

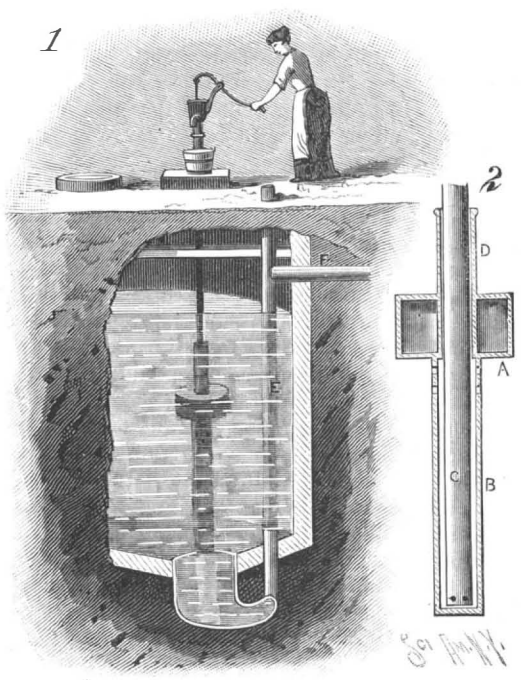
The British War Ship Undaunted.

H. M. S. Undaunted (12), belted cruiser, lately steamed out of Plymouth Sound into the channel for a final contractors' four hours' trial of her machinery with forced draught. The vessel was ballasted with heavy weights in order to bring her down to her deep load line draught, the same as if she had all her stores, guns, ammunition, coals, and crew on board ready for sea. Her draught of water forward was 20 ft. and aft 22 ft. The result of the trial was as follows:

Starboard engine horse power, 4,204; port engine horse power, 4,398; for both engines, 8,602, or 102 over the power contracted for, which was 8,500. The highest power obtained was 9,020, or 520 above what was contracted for. The speed of the ship on the measured mile was 19·4 knots per hour, which is the highest speed attained by any of her Majesty's heavily armed ships of war. The wave line was measured, and the curve proved that the protective belt was above and below the water line in the position as originally intended in the design. The Undaunted is the second of five vessels of the same class ordered about two years ago by the Admiralty. Messrs. Palmer & Co. have done important work in completing the two vessels intrusted to them to build, and which are the first two of the five. This vessel previously had a natural draught trial, when she attained a speed of over 17 knots, and indicated 5,640 horse power during the four hours' run, the maximum horse power being 5,890, or 390 horse power above the contract, which was 5,500.

AN IMPROVED CISTERN DEVICE.

The illustration herewith shows a form of cistern and pumping arrangement by which water can always be drawn from the interior of the water in a cistern, avoiding both the scum on the surface and the sediment at the bottom. It has been patented by Mr. George A. Allen, of Madison, N. J. The cistern is made with a

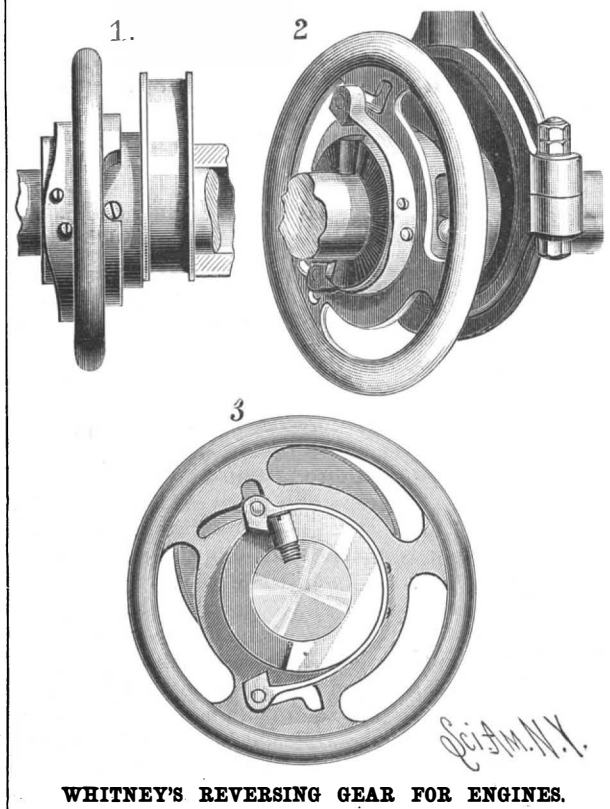


ALLEN'S CISTERN.

bottom trap or elbow, this portion being preferably of glazed earthenware, and with it is connected an overflow pipe and branch, E, F. The open top of the pipe, E, prevents siphoning, and provides for the insertion of a suction pump, whereby sediment may be withdrawn. The pump pipe, C, is fitted, over its lower portion, with a slip tube, D, having an enlarged lower portion, B, and a float, A, the latter always locating the height of the slip tube in such way that the supply of water taken by the pump will be drawn from the holes in the slip tube beneath it in the body of the water, the slip tube being closed at the bottom.

AN IMPROVED REVERSING GEAR FOR ENGINES.

The invention herewith illustrated provides a novel form of reversing gear for engines, which has been patented by Mr. Edwin H. Whitney, of Providence, R. I. Fig. 1 shows a side elevation of the reversible eccentric, with hand wheel for operating it, Fig. 3 being a front elevation showing the engine shaft in cross section, and Fig. 2 a perspective view illustrating the application of the invention to an upright engine. The eccentric is formed with a hub having shoulders to engage a stop pin on the shaft, in combination with an operating wheel placed on the hub of the eccentric, and having a limited rotary motion thereon. The eccentric has a limited independent motion upon the shaft, and the hand wheel has a rotary motion



WHITNEY'S REVERSING GEAR FOR ENGINES.

independent of the eccentric, combined with spring catches arranged to lock the hand wheel to the shaft.

Further information relative to this invention may be obtained of the American Ship Windlass Company, George Metcalf, treasurer, Providence, R. I.

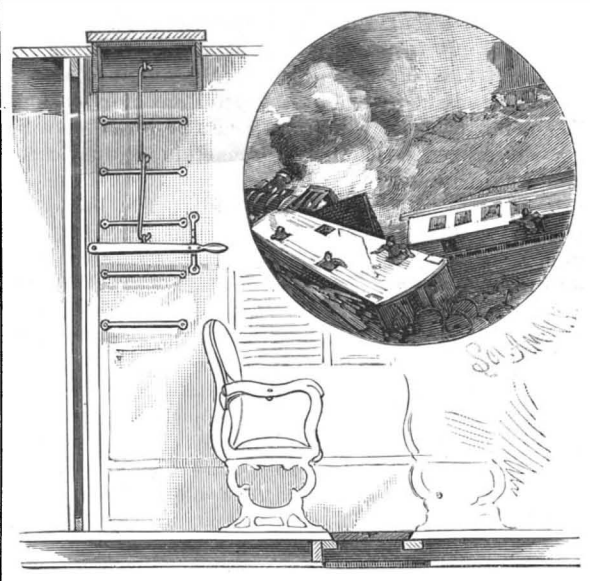
Electricity a Form of Matter.

Mr. Carl Hering, writing to the *Electrical World*, says:

"It is a well-known fact that quantity of electricity measured in coulombs never is generated, never is consumed, and never does grow less, excepting leakage. The current flowing out of a lamp is exactly the same in quantity as that going into it; the same is true of motors and of generators, showing that electricity of itself is neither consumed while doing work nor is it generated. After doing work in a lamp or motor, it comes out in precisely the same quantity as it entered. A battery is not able to generate quantity or coulombs of electricity; all it is able to do is to take the quantity which pours in at one pole and send it out at the other pole with an increased pressure, or E.M.F. Electricity, therefore, is not merely force (or a form of energy), but matter. It is precisely analogous to water in a water circuit. The water is neither consumed nor generated. The pump merely increases the pressure of the water which flows in at one end. The water motor merely consumes the pressure, and converts it into mechanical work of another kind. It does not consume the water. The quantity of water, measured in units of quantity, is the same in all parts of a closed circuit of water," etc.

A SAFETY APPLIANCE FOR RAILROAD CARS.

The invention herewith illustrated provides means by which escape can easily be made from railroad cars in case of accident, and has been patented by Mr. Thomas G. Gilfillan, of Union, Oregon. Openings are formed in the roof of the car, which are fitted with trap doors, from each of which depends a hooked bar, the lower end of which is engaged by the head of another bar, the latter being held down, to keep the trap door closed, by a hand lever, engaged by a vertical toothed bar. Upon releasing the lever from the toothed bar, the trap door may be readily raised or removed,



GILFILLAN'S SAFETY CAR.

and, iron steps or rails being attached to the side of the car, on both the inside and outside, a ready means of escaping from the car is thus afforded when other methods of egress might be cut off. In addition to these openings in the roof, similar openings, provided with trap doors, are arranged in the floor of the car.

Banana Liquor.

The *Indian Agriculturist* calls attention to the fact that India abounds in bananas or plantains, and wonders that the fruit has never been employed in the distillation of a fermented liquor. The common prickly pear has been utilized for this purpose in Malaga, and with considerable advantage to the distillers; and it now appears that missionaries in the Congo region have discovered that a beverage made of bananas is a preventive of malarial fevers. A banana liquor company has recently been started in India for producing banana liquor in either an alcoholic or non-alcoholic form, and which can be used with equal advantage as an ordinary liquor or diluted with hot or cold or soda water. For the temperatures of northern regions, including England, it will probably be best esteemed in conjunction with brandy or other spirits.

A New Torpedo Boat.

The Secretary of the Navy invites proposals for the construction of one first-class torpedo boat, complete, exclusive of torpedoes and their appendages, the vessel to be of the best and most modern design, to be constructed of steel of domestic manufacture, having a tensile strength of not less than 60,000 pounds per square inch, and an elongation in eight inches of not less than 25 per cent, and to have the highest attainable speed. Proposals will be received until November 1 next. Premiums will be paid or penalties exacted according as the speed of the vessel shall be above or below 22 knots per hour. The cost of the vessel, exclusive of premiums, is limited to $90,000.

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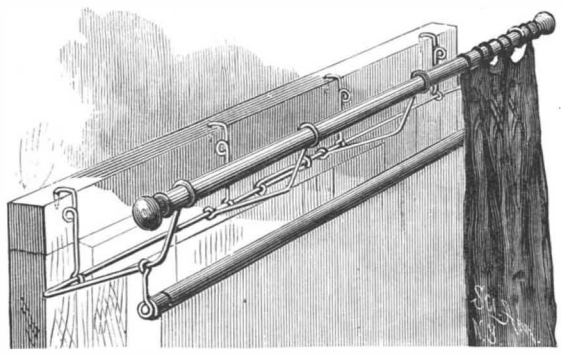
AN IMPROVED WARDROBE HOOK AND SHADE FIXTURE.

The invention herewith illustrated provides an article of simple and cheap construction, to be used either as a wardrobe attachment or as a curtain and shade fixture, and has been patented by Mr. James Fanning, of No. 15 Becket St., Salem, Mass. The main longitudinal wire is made in two sections, the inner ends looped around each other, so that this wire may be shortened or lengthened as desired to adapt the device for use in dif-

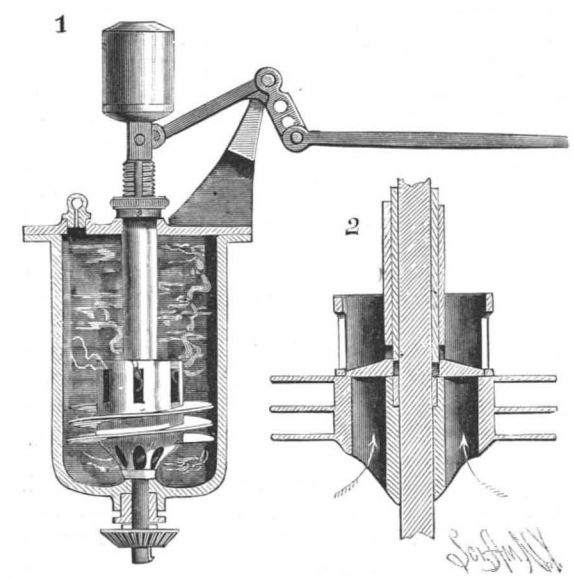


FANNING'S WARDROBE HOOK AND SHADE FIXTURE.

ferent positions. The hooks which engage the window casing or other woodwork have downwardly bent spurred ends, the outwardly curved hooks being adapted for supporting hats and other articles of wearing apparel, while their eyes and loops are calculated to receive and support a curtain pole and shade roller, as will be readily understood from the illustration.

AN IMPROVED GOVERNOR.

A governor which is designed to secure a constant given speed, however variable may be the work required of the motor, and which is applicable to heat engines, dynamos, and other machinery, is shown in the accompanying illustration, and has been patented by Mr. Alexandre Dieu, of No. 343 West Thirty-fifth Street, New York City. In a receptacle adapted to be filled with a suitable liquid, as oil, is journaled a vertical shaft carrying on its lower end a bevel gear adapted to be rotated in the usual way from a rotary part of the motor. Sliding vertically upon the shaft, but compelled to turn with it, is a governing screw upon a cylindrical core, the blades of the screw revolving in close proximity to the inner cylindrical surface of the receptacle, and there being a series of vertical passages in the screw core forming communication between that part of the interior of the receptacle below the screw and that above. Such communication may be interrupted or regulated by means of a valve plate, shown in Fig. 2, which is operated by an annular milled head upon the upper end of a sleeve which projects through the receptacle cover. Inside this sleeve a tubular rod surrounds the vertical shaft, its lower end resting in a recess in the top of the screw core, the rod being raised by and falling with the governing screw, and carrying a weight on its upper end connected by an elbow lever with a rod arranged to regulate the power supply. The revolving screw produces a constant upward circulation of the liquid, at the same time raising the screw and with it the weighted rod and the adjusting sleeve, with its valve plate, the governing action being dependent upon the speed of rotation of the screw and the extent of the opening of the vertical passages in the screw core. On varying the latter, by means of the adjusting sleeve, the re-



DIEU'S SPEED GOVERNOR.

action upon the screw can be varied so as to regulate the point of equilibrium between such reaction and the weighted screw system, to increase or decrease the speed at will without destroying its constancy.

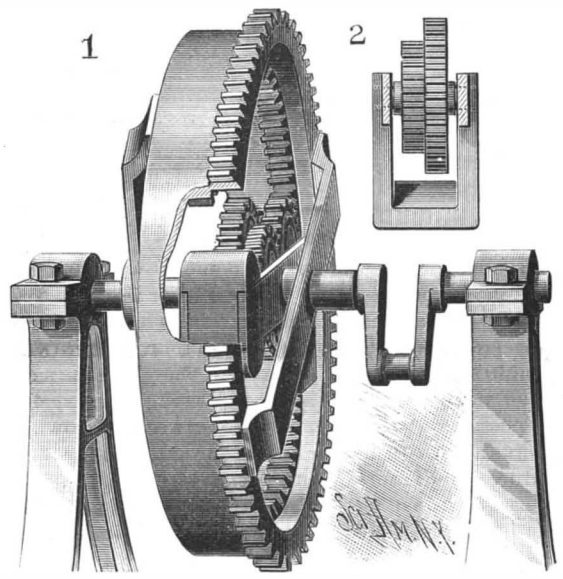
SIR WILLIAM ARMSTRONG'S new gun to resist torpedo attacks is a thirty-pounder, and develops a muzzle velocity of 1,900 feet per second.

Eighth Annual Convention of the Photographers' Association of America.

The annual convention of the above association is to be held at Chicago, Ill. The period of the meeting is from August 9 to August 11. The meeting will be under the presidency of Mr. G. Cramer, of St. Louis, so well known to all dry plate workers. The society, as its name indicates, is open to all workers in the art, whether professional or amateur. The convention is to be held in the Exposition building, situated on the shores of and overlooking the lake. The plan of the meeting provides for the exhibition of photographs and appliances. Numerous prizes are offered; many are presented by manufacturers for the best work done with their specialties. The rules as to the display and labeling of exhibits are so well conceived as to avoid the possibility of any undue prominence being given to any exhibitors. Thus pictures to be exhibited in the art hall are not to have any marks indicating what paper, lenses, or plates were used in their production. Pictures conflicting with this and other similar rules may, however, be exhibited in the stock dealers' department. As the professional as well as amateur photographers take part in this convention, a most valuable and interesting series of exhibits is assured.

AN IMPROVED GEARING FOR TRANSMITTING POWER.

An effective and economical means of transmitting power is shown in the accompanying illustration, and has been patented by Mr. John Ljung, of Nelson, Minn. On a shaft carrying a U-shaped crank arm is secured a small gear wheel, which meshes into an intermediate gear wheel secured to a shaft having its bearing in a counterbalanced frame, which turns loosely on the crank arm shaft. The intermediate gear wheel meshes into an internal gear on the large transmitting wheel, which is connected either by belt passing over the wide



LJUNG'S GEARING.

portion of its rim, or by the gear on one outer edge, with the machinery to be driven. Fig. 2 shows sectional end elevation of the swinging frame and intermediate gear wheel, the shaft carrying the gear wheel of the counterbalanced frame carrying also another gear wheel, which meshes into a corresponding gear wheel upon the crank-arm shaft.

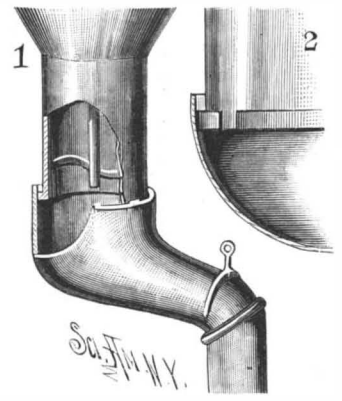
Effect of Heat upon the Strength of Metals.

A series of interesting experiments has been conducted in Portsmouth Dockyard for the purpose of ascertaining the extent to which different gun metal compositions, and iron and steel, are affected as regards their strength and ductility by being heated to various temperatures not exceeding those to which they may at any time be exposed as parts of machines and structures. It has occurred to most engineers to observe instances of damage due to the overheating of bearings, etc., which have indicated that certain changes had taken place in the metals exhibiting this phenomena. In some gas making processes, moreover, gun metal and iron fittings are required to be exposed, while under pressure, to hot gases and superheated steam; and it is important to know the effect of this condition upon the strength of the materials in question. The Portsmouth experiments (the results of which are detailed in *Industries*) dealt with temperatures advancing by steps of 50° from the atmospheric to 500° Fah. The method of heating the specimens was by an oil bath, and every care was taken to complete the tests before the specimens lost their heat.

The result of the experiments went to show that with all bronzes there is a regular, but not serious, decrease of strength and ductility up to a certain point, which depends to some extent upon the composition of the bronze, beyond which the strength suddenly drops to about one-half, and the ductility vanishes. This critical point for ordinary gun metals is between 300° and 400° Fah. Phosphor-bronze preserves two-thirds of its strength and one-third of its ductility up to 500° Fah.; and Muntz metal and pure copper are also fairly satisfactory in these respects. Wrought iron increases in strength up to 500° Fah., but loses in ductility up to 300° Fah.; after which an improvement begins, and lasts up to 500°. It is more ductile at atmospheric temperatures than when warmed. The strength of open-hearth steel is not affected by warming to 500° Fah., but its ductility is reduced by one-half.

A SACK-FILLING SPOUT FOR FLOUR PACKERS.

An improved means of conveying flour from the auger tube to the sack is shown in the accompanying illustration, and has been patented by Mr. Ossian A. C. Conant, of Terre Haute, Ind. The bent tube, intended for attachment to the auger tube, is provided with lugs, which pass through apertures formed in the lower binding hoop of the auger tube, as shown in Fig. 2, and to the lower end of the bent tube there is secured a flexible tube of sacking. A slide or cut is arranged in the bent tube to intercept the flow of flour, which is otherwise continuously forced down by the auger within the vertical tube.



CONANT'S FLOUR PACKER.

A Garden Barometer.

One of the simplest of barometers is a spider's web. When there is a prospect of rain or wind, the spider shortens the filaments from which its web is suspended and leaves things in this state as long as the weather is variable. If the insect elongates its threads, it is a sign of fine, calm weather, the duration of which may be judged of by the length to which the threads are let out. If the spider remains inactive, it is a sign of rain; but if, on the contrary, it keeps at work during a rain, the latter will not last long, and will be followed by fine weather. Other observations have taught that the spider makes changes in its web every twenty-four hours, and that if such changes are made in the evening, just before sunset, the night will be clear and beautiful.—*La Nature.*

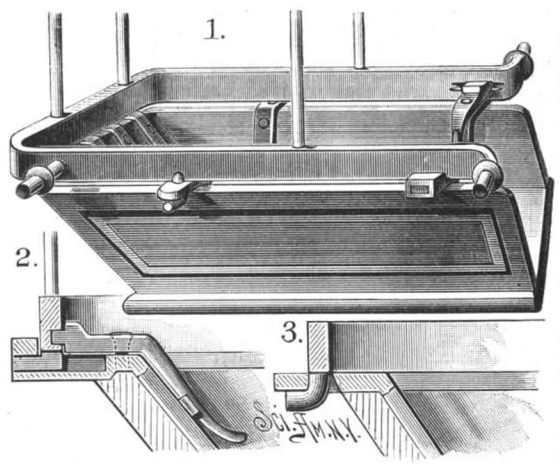
Railroad Horses.

English railroads do the major portion of their own carting, collecting and delivering freight at the freighters' doors. One of the largest companies, the Midland, have in constant employment no fewer than 3,200 horses; and of these 1,000 are located in London.

Some of these horses are, however, employed in switching cars, at which business a heavy horse weighing about 2,000 lb. can do good service. They soon become very expert, and start the car by standing with the trace chain slack, and then, without moving their feet, throw their shoulders forward, when their weight starts the car. They also learn to judge when the car has acquired sufficient speed, and step aside without a word of command, letting the cars come gently together.

ATTACHMENT FOR TOP RAIL OF VEHICLE SEAT.

A means of attaching the top rail of a vehicle seat without the use of bolts or nuts is shown in the accompanying illustration, and has been patented by Mr. John W. Yous, of Mound City, Missouri. Metal straps secured to the back of the seat, and projecting from its top, are adapted to receive rearwardly projecting hooks formed on the top rail, as shown in Fig. 3. To the ends of the seat are attached straps having sockets with lateral openings for receiving right-angled fingers



YOUS' VEHICLE SEAT.

projecting downward and outward from the forward ends of the top rail, as shown in Fig. 2, these straps having pivoted latches, adapted to press against the inner side of the top rail, which is readily engaged with the hooks at the back and sprung into place and secured by the latch at the side. By this means the top rail is securely held, and may be attached or removed without the use of wrenches or other tools.

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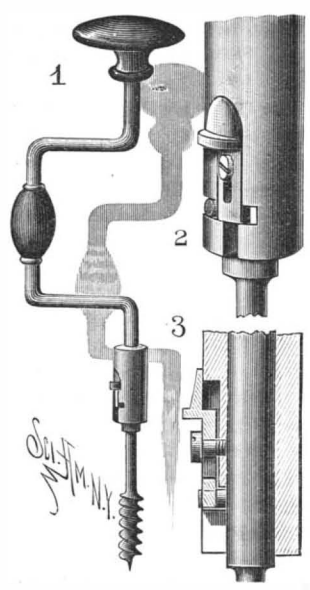
AN IMPROVED BIT BRACE.

A simple construction of bit stock and bit shank, in which the parts are not liable to displacement or breakage, is shown in the accompanying illustration, and has been patented by Messrs. George Gavin and Lawrence W. Cromer, of Eureka, Nevada. The socket of the bit stock has a cylindrical bore adapted to receive a similar cylindrically shaped bit shank, provided above its shoulder with a pin, which, when the bit shank is in position within the socket of the bit stock, engages either end, as desired, of the horizontal arm of a T-slot. A vertical groove is cut in the face of the bit stock above the T-slot, in which slides a bolt that is held in position by a set screw, this bolt securely holding the pin of the bit shank in either division of the T-slot, as plainly shown in Figs. 2 and 3. It is only necessary to employ the sliding bolt when the bit stock is attached to a ratchet brace, the bit stock being complete without the bolt for use with ordinary braces. This invention may also be applied with augers and auger handles, and for other purposes.



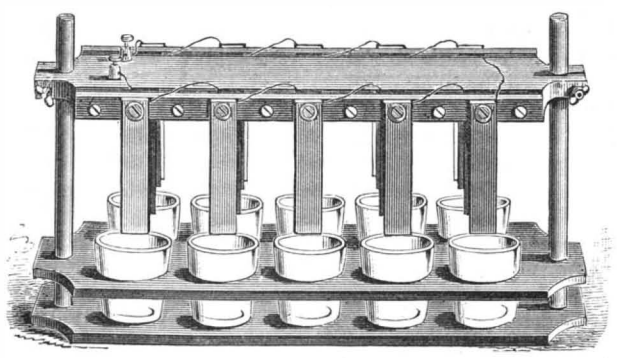
GAVIN & CROMER'S BIT BRACE.

SIMPLE PLUNGE BATTERY.

The engraving represents an inexpensive and easily made plunge battery, which is very convenient for temporary use.

Twelve tumblers, arranged in two rows of six, are held in place by an apertured board supported a short distance above the base board by the round standards. To the standards is fitted a board which is split from the standards outward, and provided with two bolts with wing nuts, by which the board may be clamped at any desired height on the standards. To opposite edges of this movable board are clamped six plates of carbon, 1¼ inches wide, ¼ inch thick, and 6 or 8 inches long. The upper ends of the carbon plates are heated and saturated with wax or paraffine, and a copper wire is interposed between the carbon plate and the edge of the board. The strips of wood by which the carbons are clamped are ⅜ inch thick. To these wooden strips are secured zinc plates of the same dimensions as the carbon plates, by means of ordinary wood screws passing through holes in the zinc into the wood. The wires connected with the carbon plates are bent over and inserted between the zinc plates and the wood, as shown in the engraving. That is, the carbon of one pair is connected with the zinc of the next pair in order, and so on throughout the series, and the terminal plates are connected with the binding posts.

The zincs are amalgamated, and the tumblers are nearly filled with a solution consisting of bichromate of potash dissolved in water to saturation, a quantity of sulphuric acid, equal in bulk to one-fifth of the bichromate solution, being slowly added.


SIMPLE PLUNGE BATTERY.

To maintain the amalgamation of the zincs, a small quantity of bisulphate of mercury is added to the bichromate solution, say ¼ ounce to every quart of solution.

The tumblers should be as large as can be conveniently obtained. Those holding one pint are not too large.

The zincs and carbons may be connected up in different ways for different effects. For example, all of the carbons may be connected together and all of the zincs may be connected in the same way, thus securing a quantity current having the electromotive force of only a single cell; or all of the zincs on each side may be connected together, and all of the carbons may be connected in the same way, and the series of zincs on one side may be connected with the series of carbons on the other side, thus giving a current having the electromotive force of two cells and the quantity of six. G. M. H.

The World's Largest Cities.

The following information is often inquired for, and, as it may be useful in many cases for reference, we have compiled a table of the largest cities of the world, with their populations as stated by the latest authorities. In the absence of any official census, the Chinese cites have simply to be estimated, and, of course, must be accepted as an approximation only. We have not given any city whose population is below 500,000, though there are many we could enumerate which closely approach that figure. It will be seen that in the thirty-five cities tabulated below there are 32,510,319 souls, or nearly the population of the British Isles, a fact which cannot be grasped in a moment by any ordinary intellect.

Aitichi, Japan	1,332,050
Bangkok, Siam	500,000
Brooklyn, N. Y.	771,000
Berlin, Prussia	1,122,330
Calcutta, India	766,298
Canton, China	1,500,000
Changchoofoo, China	1,000,000
Chicago, Ill.	715,000
Constantinople, Turkey	700,000
Foo-choo, China	630,000
Glasgow, Scotland	514,048
Hang-Chow-foo, China	600,000
Hang-Tcheon, China	800,000
Han-Kow, China	600,000
King-te-Chiang, China	500,000
Liverpool, England	573,000
London, England	3,955,819
Madrid, Spain	500,900
Moscow, Russia	611,974
New York, N. Y.	1,400,000
Paris, France	2,269,023
Pekalonga, Java	505,204
Pekin, China	800,000
Philadelphia, Pa.	850,000
St. Petersburg, Russia	766,964
Sartama, Japan	962,917
Sian, China	1,000,000
St. Louis, Mo.	500,000
Tat-Seen-Loo, China	500,000
Tien-Tsin, China	950,000
Tokio, Japan	987,887
Tschautchau-fu, China	1,000,000
Tsin-Tchoo, China	800,000
Vienna, Austria	726,105
Woo-chang, China	800,000

—*Pall Mall Gazette.*

Tariff Revision.

The revision that is sure to come is sure, also, to be made in one of these two ways: Either in the interests of protection and labor here on our own soil, or in that of foreign production and foreign labor. There can be no middle ground, any more than there can be service of two masters. There is a grand struggle going on for the possession of our markets between our own producers and our own labor on the one side and the foreign producer and laborer on the other—and he that is not for us is against us. When the citadel is assaulted, even indifference helps the enemy. The industries of this country and its labor in every calling and pursuit have no option left them, but are called upon, in an inevitable revision of the laws that have created and fostered them, to defend their markets here against foreign invasion.

There are those who talk much of the necessity to us of foreign markets, and are ready to surrender our own to secure them. Do not listen to such preaching. The nation which cannot command its own markets cannot command foreign markets, for those conditions of production which will enable a foreign producer to undersell us here will enable him to undersell us in distant markets, where cost of transportation must be added to cost of production here. Every mile of distance to market is a dead charge upon production, and every mile cut off is a direct addition to profit. Seek first and all the time the nearest market, and make it and all possible augmentation of it your own, and then, if ever, will be added the facilities and opportunities of trade and commerce the world over which are sure to come to that people whose highest attainment in production is the result of the greatest variety and development of their own industries. This is the sure and only way to the markets of the world consistent with health and prosperity at home.—*H. L. Dawes' address at the recent meeting of Amer. Paper Mfrs.' Assn., Saratoga.*

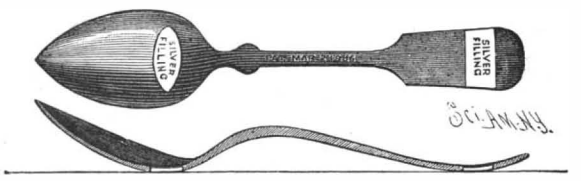
Fireproofing Solution.

For rendering fabrics, wood, and other inflammable objects fireproof, a writer in *La Nature* recommends borotungstate of soda, a salt which he states has never hitherto been employed for the purpose. It is made by dissolving boric acid in a hot solution of tungstate of soda. Objects impregnated with this solution are rendered incombustible. The solution gives off no deleterious gas, while ammoniacal salts, phosphate of ammonia, and salts of phosphorus render the air irrespirable.

Borotungstate of soda in solution is also said to possess valuable antiseptic properties, and has been used with the greatest success in diphtheria, for dressing wounds, and as a wash in cases where an antiseptic is needed. The solution has no odor, but its taste is bitter.

IMPROVEMENT IN MANUFACTURING PLATED WARE.

The invention herewith illustrated provides a method of manufacturing plated ware in which the parts most exposed to wear are filled with precious metal or alloy, as, for instance, the bottom of the bowl of a spoon or the back of the handle of a fork, these being the usual points of rest from which the plating on such articles generally wears off the quickest. In such goods, and all flat plated ware of a similar kind, a recess is made at these points of rest, or places of greatest wear, and this recess is filled, in the process of manufacture, with fine or coin silver, or other metal corresponding with that used in plating, so that, after the whole is plated, abrasions of these parts will not, as in the ordinary plated ware, expose the baser metal or alloy of which the article is mainly composed. The illustration shows



WARNER'S PART SILVER-FILLED SPOONS.

the method of inserting this silver filling in a standard style of silver-plated teaspoons.

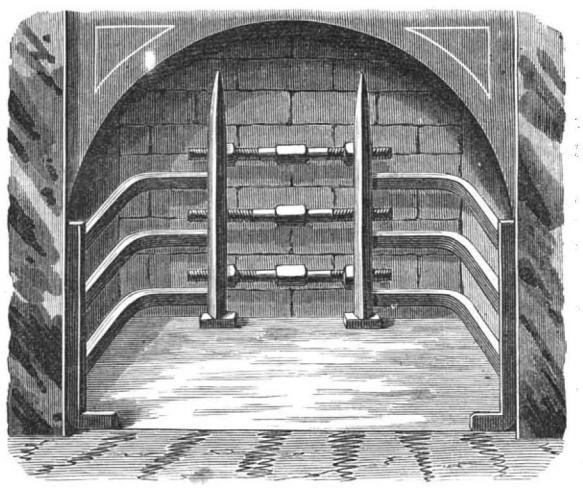
This invention has been patented by Mr. William A. Warner, of Syracuse, N. Y., and articles made after this method are now being manufactured by Messrs. Warner Brothers, of that place.

Removing Rust from Iron.

It frequently causes much trouble, indeed, in some cases defies all efforts, to free iron from ingrained rust, but according to a German paper the thorough cleansing of it may easily be effected by immersing the article in a nearly saturated solution of chloride of tin, even if much eaten into. The duration of the immersion will depend upon the thicker or thinner film of rust; in most cases, however, twelve to twenty-four hours will suffice. The solution of chloride of tin must not contain too great an excess of acid, otherwise it will attack the iron itself. After the articles have been removed from the bath they should first be washed in water and then with ammonia, and be dried as quickly as possible. Articles treated in this manner assume the appearance of dead silver.

AN IMPROVED FIRE-PLACE PROTECTOR.

A device designed to protect the brickwork of fireplaces, preventing the fire from resting against the brick, and so constructed that the protector may be adjusted for use in fire-places of different size, is shown in the accompanying illustration, and has been patented by Mr. George W. Meharg, of Kennett, Dunklin County, Mo. To the two outer standards are connected rearwardly extending bars, bent at inner corners, and supported at their other ends by two other standards, in which are threaded apertures arranged to receive screws formed with right and left hand


MEHARG'S FIRE-PLACE PROTECTOR.

threads, and with central heads. In order that the exposed surface of the central standards may be as small as possible, they are made substantially triangular in cross section, the forward edge of the standards being the apex of the triangle, and jamb nuts are arranged on the screws to bind the parts in place when they are once properly adjusted.

Volcanic Silver.

Professor Mallet has analyzed a specimen of volcanic ash collected on the Pacific cost in Ecuador, 120 miles west of Cotopaxi. The ash fell on July 23, 1885, and formed a deposit to the depth of several inches. The interesting feature in the composition of the material was the presence of a small amount of silver, probably as silver chloride; several experiments showed that silver was present to the extent of 1 part in 83,600 of ash. This is the first time that silver has been identified in material ejected from a volcano.—*Proc. Roy. Soc.*

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Water in Thermometer Tubes.

It has long been known that thermometers, when made from recently blown tubes, changed their register with lapse of time. The glass seems to undergo a very slow alteration in volume, which alteration extends over several years before a final volume is reached. The cure for this trouble is obvious. The tubes may be blown, filled with mercury, and sealed, and then may be graduated after standing a year or more. This method is obviously only practicable for the finer class of instruments; but it does provide effectually for such.

In thermometers constructed for very high or very low temperatures, abnormal readings have been noticed which often have been considered inexplicable. But in some cases a cause for startlingly large errors has been found in the presence of water in the tube. A thermometer made with every precaution, by one of the makers of highest standing in this city, was recently shown by him. It was made for the higher temperatures, the scale extending from 90° to 440° Fah. After it had been used for a few months, it was, with a number of others, returned as useless, on account of inaccuracy. On inspection, a considerable amount of water, enough to fill three-quarters of an inch of the bore, is seen to be contained within it. This accounts for its erroneous register. More or less of the water is of course mixed with the mercury, and at the high temperatures is converted into steam, rendering the readings valueless. The steam cushion formed above the mercury also would, to some extent, affect its readings.

Of the other thermometers, one showed the presence of a minute amount of some gas, quite possibly of water vapor. A small break existed in the column of mercury near the bulb. If the tube was inclined, this break expanded from a small fraction of an inch to an inch or more. This occurred just before the tube reached the horizontal position. The pressure of a column of mercury a few inches high was enough to compress the vapor to its original and very small volume.

These instances of errors are supplemented in the experience of the same maker by similar trouble found in a low degree instrument. This was made for use in a freezing machine, and when exposed to low temperatures, registered many degrees below the true standard. The maker examined it, comparing it with other thermometers, and tested its accuracy rigorously. He could find no cause for the trouble. From his examinations alone, it appeared that the thermometer was accurate. Exposed to the exceedingly low temperature, it again was found wrong.

The cause of the trouble with the high temperature instruments is evident. Somewhere a crack must exist, through which water or air has been drawn. This undoubtedly happened at the higher temperatures. At ordinary heat the crack is probably hermetically closed. Those who have manipulated glass know that a crack may exist and be quite invisible. The surfaces of the crack may be in such intimate contact that no evidences of the fracture can be seen. Such a crack, or several of them, may have been developed in the glass of the erroneous instruments by the sudden changes of temperature to which they were subjected. On being immersed in a hot solution, the crack may admit some water. A vacuum exists in a thermometer tube, rendering available the atmospheric pressure for forcing water in.

The sudden changes of temperature are inevitable in technical use. A confectioner must plunge his thermometer directly into his sirups; he cannot stop to bring it gradually to the maximum temperature to which it is to be exposed. A thermometer that would stand this treatment is, in a commercial sense, a desideratum. Many such undoubtedly exist, but enough has been said to show that the maker cannot feel confident of any of his instruments, if to be thus treated. A good subject for investigation and invention is here afforded.

The low degree errors are a still more difficult subject. The occurrence cited is probably more of an anomaly than is the other. But it indicates that the perfect low degree as well as high degree thermometer is still to be devised.

Manufacture of White Bread.

Within a recent period experiments have been carried on in Germany, which have met with full success, relating to making bread of the best possible appearance, though from such flour as usually is only made into bread with difficulty. The new improvement suggested consists in the addition of those materials which normally exist in flour from certain regions, and which are wanting in that from elsewhere. For example, the attempt was made to add a part of those components which give its value to the flour of Hungary and of Russia, or what amounts to the same, to add such substances as would bring about the production of products of equally good quality. It is known that carbonic acid gas, which is produced in the fermentation of bread dough, and which makes the loaf porous, comes from the decomposition of maltose. Apparently maltose either does not originally exist in equal proportions in all cereals, or its formation from starch does not occur with equal facility in all flour. When this last is the case, saccharification will be accompanied by peptonization of the gluten, which will seriously deteriorate the quality of the bread.

This makes it clear how the addition of maltose to the flour, in proper proportions, in all cases should facilitate the alcoholic fermentation, and, assisting the development of this, should retard the operation of the false ferments, which tend to darken or sour the dough. The treatment is easily carried out: Maltose sirup in the proportion of about 2 per cent of the weight of the flour is dissolved in the water used in mixing the dough. The quantity of leaven remains the same, and the fermentation occurs with rapidity and vigor. When the baking is executed at the proper time (as determined by experience), a product of most beautiful appearance is produced, yet has no sweet taste, because the maltose has entirely disappeared, being converted into alcohol and carbonic acid gas.—*L'Industria.*

Industrial Education in the Minneapolis High School.

A manual training school, under the instruction of Prof. F. W. Decker, has lately been established by the school board of the city, in connection with the high school, and results have already been obtained that promise well for the success of this new enterprise.

The object of the course is not to make finished mechanics in any definite trade, but rather to give a general training that shall serve to render boys familiar with common tools and materials of construction, and lay a good foundation for any one of the several mechanical trades

The course serves also to correct some of the popular notions among boys that manual occupations are degrading, or at any rate not so respectable as occupations requiring only book knowledge. This latter result is attained by placing the manual training course on an equal footing with other high school courses, and requiring the same attention to system and order as in any branch of knowledge taught.

The course for the present term is woodworking.

A large lower room of the high school building has been fitted up with benches and drawers and a variety of woodworking tools.

Each bench is provided with a full set of bench tools, and each boy has, besides, a number of edge tools and a drawer in which to keep them locked when not in use. Each boy is required to keep his individual tools in order, and all the bench tools have their proper places on a rack in front, where they must be placed at the end of each exercise. The benches and bench tools are lettered to correspond, so that it is easy to see at a glance that everything is in its proper place.

The use of the tools is taught in the following manner, it being assumed there is only one right way. The boys are each given a plane, for instance, and, after being shown the nature and construction of the tool, they are shown how to use it properly. All this is taught to them as a class. They are then given each a piece of board and are required to produce a plane surface, each being drilled until he is tolerably proficient in the use of the tool before being allowed to go on. Sawing is taught in a similar manner. The saw is first discussed, and the reason for the teeth being shaped differently for cross-cut and rip saws is pointed out. A board is then marked with a scratch awl, and the class is shown how to saw to line accurately. They are then each required to saw to given lines until the lesson is thoroughly taught. By keeping the attention of the pupils on one operation at a time and holding it until taught, rapid and sure progress is made. After the uses of a few of the most common tools is thus taught, the boys are allowed to construct something that will bring into use only operations they have previously learned. This serves to make the work interesting, though the work is designed to be for the purposes of instruction rather than construction.

Whenever an article is constructed, it is done from an accurate working drawing made by the pupil himself, and thus the value of drawings, in connection with all construction work, is taught better than it could otherwise be done.

Each pupil is required to spend forty minutes per day in the drawing room and eighty minutes in the shop. Drawing is taught in much the same manner as the use of the tools just described, and it is found that the two branches of work go very nicely together. It was first planned to provide for a class of eighteen only, the class being in three divisions of six, each division spending, as before stated, eighty minutes in the shop and forty minutes in drawing.

The work at once became so popular, however, that the limit was increased to thirty, with several more anxious to join the class, but barred out for want of tools and shop room. Provision will probably be made for double the present number at the beginning of the new school year, and a new building is already talked of, to be provided in the near future.

The school board has also established an evening school of drawing, which has been attended during the winter by over fifty pupils, mostly young mechanics, who are busy during the day.

Instruction is given in this school in both mechanical and architectural draughting after the first principles are mastered; and the interest manifested in the work shows plainly that it is valued as an aid to mechanics in their daily occupations. This school was first established a little over a year ago, but the attendance latterly has been nearly double that of the first season; many of those now attending were present last year.

The most advanced pupils are at present engaged in such work as laying out and projecting bevel gearing, using the correct curves for the teeth, and showing finally the wheels in working position with two sets of teeth in contact. Others are making perspective drawings of objects of given dimensions, with the eye assumed in a given position.

A greater number are employed in making accurate projections of parts of buildings and machinery, working in all cases from dimensions given, rather than being allowed to simply copy.

The outlook promises much for the future of industrial education in our public schools.—*T. T. Journal.*

The Phosphorescence of Sulphate of Lime.

M. Verneuil has recently investigated the cause of the phosphorescence of sulphate of lime, the ingredient of luminous paint. In order to prepare it so as to give a violet phosphorescence, it is sufficient to calcine a mixture of 100 parts of cockle shell lime (*Hypopus vulgaris*), 30 parts of sulphur, and 0·02 part of subnitrate of bismuth. Pure lime does not give the phosphorescence when mixed with these materials. Hence M. Verneuil has analyzed the cockle lime and found it to contain: Lime, 54·95 per cent; carbonic acid, 43·26; carbonate of soda, 0·99; chloride of sodium, 0·06; silica, 0·02; magnesia, 0·01; insoluble matter, 0·04; organic matter and waste, 0·67 per cent; and traces of phosphoric acid. M. Verneuil then ascertained that a fine phosphorescence could be obtained by adding to pure carbonate of lime the foreign substances which analysis reveals in the cockle lime. It follows from his experiments that the violet sulphide of calcium prepared with cockle lime owes its vivid phosphorescence at once to the bismuth salt, the carbonate of soda, the sea salt, and sulphate of lime formed during the reaction, and the cockle lime seems to contain sufficient carbonate of soda and sea salt to give the maximum brightness. M. Verneuil is also of opinion that any matter capable of vitrifying the surface of the sulphite of calcium without coloring it is able to render the latter phosphorescent. It becomes phosphorescent, in fact, when it is heated to red heat on a platinum plate with a little borax, or carbonate of potash, chloride of sodium, carbonate of soda, silicate of soda, fluoride of calcium, cryolithe, fluoride of barium, chloride of strontium, chloride of barium, hydro-fluosilicate of barium, and so on. All these substances probably act in changing the molecular state of the sulphide of calcium conformably to the views of M. Becquerel.

Heating by Electricity.

Though it is claimed as one of the advantages of electricity that it does not raise the temperature of the atmosphere when used for lighting, it is nevertheless, says *La Nature*, capable, under certain conditions, of evolving heat. This property is about to be turned to profitable account by the Societe des Usines Electriques of Berlin, who have announced that, in future, in addition to light, they will be prepared to furnish a supply of electricity for heating purposes. The appliances which the society offer to their customers have been constructed in view of the use to which they are to be put. For instance, for boiling water they have contrived a vessel having two cases, between which is placed a resistance coil. It is stated that with this appliance about 1½ pints of water can be raised to boiling point with 4 amperes 100 volts. In certain theaters electric stoves are employed for heating the curling tongs, the use of gas jets and spirit lamps being rigorously forbidden.

New Russian Gunboat.

A new gunboat, built for the Russian government at Copenhagen, has arrived at Cronstadt. The vessel, which has been named the Manchuria, has been constructed of steel, at a cost of 55,000*l.* The following are the principal dimensions: Length, 210 ft.; beam, 35 ft.; displacement, 1,200 tons; draught, fore, without artillery and war material, 10 ft. 2 in.; aft, 10 ft. 7 in. The boat has two engines, with an indicated power of 1,000 horse power each. They can without any particular strain develop a speed of more than 13 knots. The armament of the Manchuria will consist of two 8 in. long-range guns in the stern, six Hotchkiss, one Baranovsky, and four nine-pounder guns The bottom of the boat is divided into forty-two water-tight compartments, and the hold is amply protected by fourteen air-tight partitions. An apparatus for ejecting Whitehead torpedoes will be placed in the vessel's bow. The average speed attained during the run from Copenhagen to Cronstadt was 11½ knots.

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H. M. S. ORLANDO.

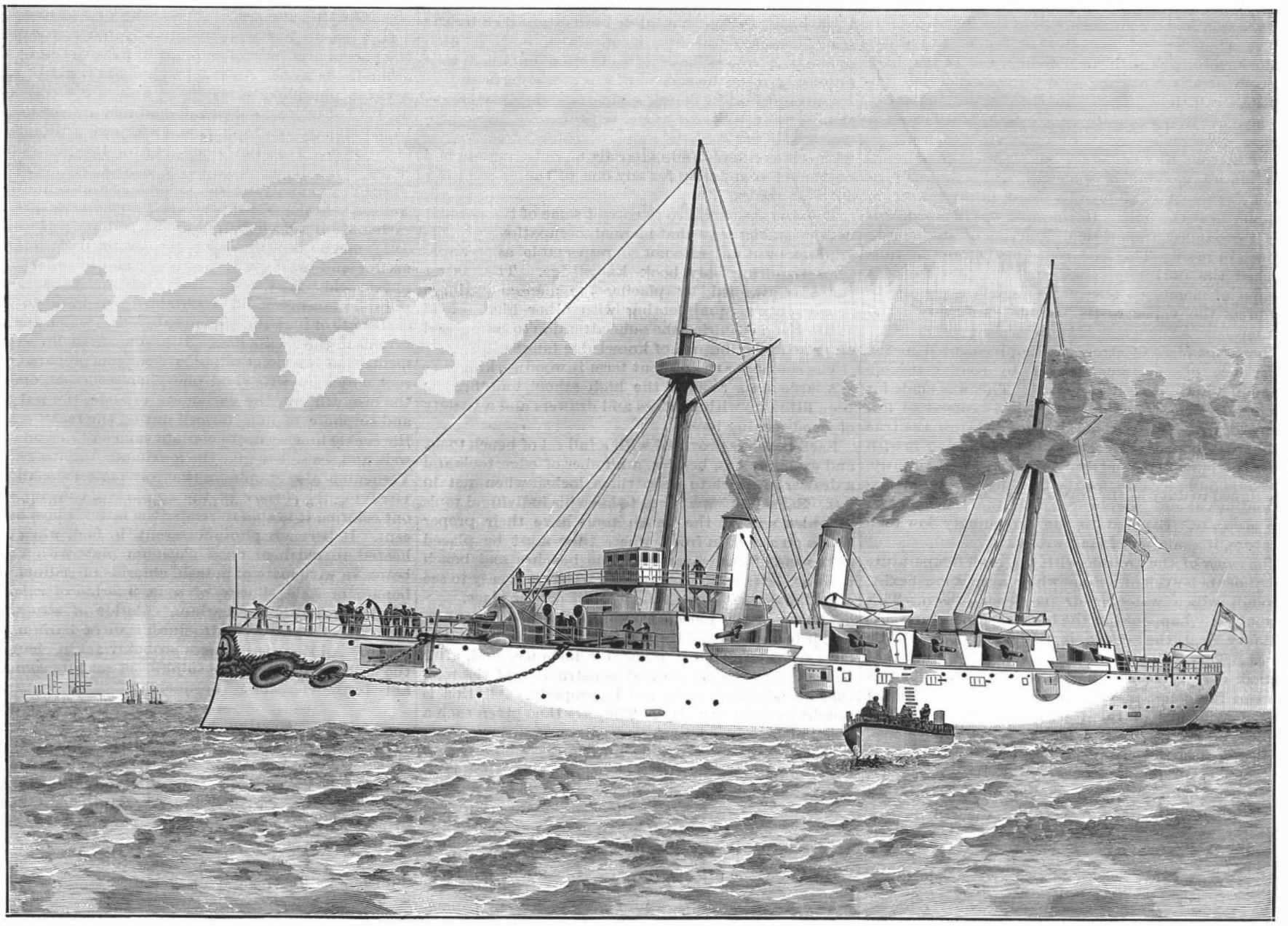
This new ship of war, built in the yard of Palmer's Shipbuilding and Iron Company, at Jarrow-on-Tyne, is the first of the belted cruiser class, of which seven are being constructed for the Royal Navy. They are quite a new departure in war ship design, and while superior to anything of this class of war vessel afloat in point of speed, are much more heavily armed and have greatly more defensive power than the Mersey class, which approach them nearest from a constructive point of view; the chief difference consisting of a belt of armor at the water line, which is fitted in the Orlando class, and from which they derive the name of belted cruiser.

The following is a general description of the vessel: Length between perpendiculars, 300 feet; breadth, extreme, 56 feet; depth, moulded, 37 feet; normal draught, 21 feet; and displacement, 5,000 tons. The estimated speed is about 19 knots. The armor is compound or steel-faced, and consists of a belt, 200 feet in length, extending from 1 foot 6 inches above the water line to 4 feet below. This belt is 10 inches in thickness, and is backed with 6 inches of teak, secured in steel plating of 1 inch thickness. On a level with the top of the belt is a protective deck, which extends throughout the whole length of the vessel. This deck, along the belt, is perfectly horizontal, and is formed of 2 inches of steel plating. Beyond the belt, at both ends, it is inclined downward to an angle of 30 degrees, and is 3 inches in thickness. All openings in this deck are fitted with either armor shutters or shell-proof gratings, and those necessarily open in action are fitted with cofferdams.

By the armor belt amidships, and the protective deck plating fore and aft, the whole of the vessel under this deck is rendered invulnerable to shot and shell, and forms an unsinkable raft, in which are placed the engines, boilers, magazines, shell rooms, and steering gear. The movements of the machinery, the steering of the ship, and the firing of the guns are under complete control from the conning tower, a massive structure at the fore end of the vessel. The look-out men in this tower are protected by 12 inch steel-faced armor, and all the communications to engine rooms, magazines, and steering wheels pass through a tube of steel 8 inches thick. The stem, which forms a ram, is exceptionally strong, and is well supported by the framework of the vessel and the protective deck. The ram, stern-post, and propeller brackets are of cast steel.

The hull is built of Siemens-Martin steel, and is divided into over one hundred watertight compartments. An inner bottom extends throughout the entire length of the engine and boiler spaces, the space between the inner and outer bottoms being divided into compartments, which are fitted as water ballast tanks. The vessel has three decks, exclusive of the platforms which cover the magazines, etc. The engines and boilers occupy four separate compartments, arranged fore and aft along the middle of the vessel, bounded on each side by coal bunkers, 5 feet in width.

The armament is exceedingly powerful, and consists of two 9·2 inch 22 ton guns, ten 6 inch 5 ton guns, six 6 pounder and ten 3 pounder Hotchkiss quick-firing guns, and numerous boat and field guns. The 9·2 inch guns are placed on the upper deck, one forward and one aft.—*Illustrated London News.*



THE NEW BRITISH WAR SHIP ORLANDO.

Dress in Relation to Health.

It has always been a stereotyped statement of physiologists that the respiration of woman differs from that of man in being limited almost entirely to the chest. On the other hand, we have the apparently contradictory fact that abdominal or deep respiration is the most potent of all factors for returning the blood through the veins to the heart. It is, therefore, a necessity for the prevention of blood stagnation in the lower portion of the trunk.

We have, at last, some investigations which promise to solve this interesting problem. These investigations tend to show that the exclusive use of the chest in respiration is a result of the restrictions of civilization, and is hence *unnatural.* In order to investigate this subject scientifically, Dr. Mays, of Philadelphia, devised an ingenious instrument for examining the respiration of the native Indian girls in the Lincoln Institution. The girls had not yet been subjected to the restrictions of civilized dress. The results of his investigations will be found recorded in the *Therapeutic Gazette* of May 16, 1887. He says:

"In all, I examined the movements of eighty-two chests, and in each case took an abdominal and a costal tracing. The girls were partly pure and partly mixed with white blood, and their ages ranged from between ten and twenty years. Thus there were thirty-three full-blooded Indians, five one-fourth, thirty-five one-half, and two were three-fourths white. *Seventy-five* showed a *decided abdominal* type of breathing, three a costal type, and three in which both were about even. *Those who showed the costal type, or a divergence from the abdominal type, came from the more civilized tribes,* like the Mohawks and Chippewas, and were either *one-half or three-fourths white;* while in *no single instance* did a full-blooded Indian girl possess this type of breathing.

"From these observations it obviously follows that, so far as the Indian is concerned, the abdominal is the original type of respiration in both male and female, and that the costal type in the civilized female is developed through the constricting influence of dress around the abdomen. This is markedly shown in the greater prominence of the costal movements in those girls who were either one-half or three-fourths white, and who were hence dominated to a greater or less extent by the influence of civilized blood. While these tracings were taken an incident occurred which demonstrated that abdominal constriction could modify the movements of the thorax during respiration. At my first visit to the institution I obtained an exceptional costal type of respiration from a full-blooded Indian girl. At my next visit I concluded to repeat this observation, and found that, contrary to my instructions concerning loose clothing, etc., this girl at my first visit had worn three tight belts around her abdomen. After these were removed she gave the abdominal type of breathing, which is characteristic of nearly all the Indian girls."

To us these facts are invaluable. It shows the faulty construction of modern female dress, which restricts the motion of abdominal respiration. It explains why, as experience has taught us, it is necessary to restore this abdominal rhythm, by proper movements, in order to permanently cure the affections of the lower portion of the trunk. It demonstrates conclusively that woman's dress, to be injurious, needs only to interfere with the proper motion of respiration, even though it exercises not the slightest compression.—*Health Record.*

The Diet of Strong Men.

The Roman soldiers who built such wonderful roads, and carried a weight of armor and luggage that would crush the average farm hand, lived on coarse brown bread and sour wine. They were temperate in diet, and regular and constant in exercise. The Spanish peasant works every day and dances half the night, yet eats only his black bread, onion, and watermelon. The Smyrna porter eats only a little fruit and some olives, yet he walks off with his load of a hundred pounds. The coolie, fed on rice, is more active and can endure more than the negro fed on fat meat. The heavy work of the world is not done by men who eat the greatest quantity. Moderation in diet seems to be the prerequisite of endurance.

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SAMUEL PIERPONT LANGLEY.

BY MARCUS BENJAMIN.

Samuel Pierpont Langley was born in Roxbury, now a part of Boston, Mass., on August 22, 1834.

His early education was acquired at the Boston Latin and High Schools, but he did not go to college, then associated almost exclusively with the idea of a classical education, as his strongest bent was to those scientific investigations which have been the occupation of his later life.

In this connection he says: "I can hardly recall the time when a treatise on astronomy, even though then unintelligible, had not a curious attraction for me; and one of my very early childish experiences was in connection with my inquiries as to the reason why the glass in a hot-bed I saw kept the contents warm. That none of the elder people I questioned saw any difficulty about it, and that I did so, seems to me to indicate an early bias to studies on such subjects as those connected with radiant heat, in which I attribute any subsequent success I may have met with largely to the fact that their pursuit has always been in accordance with my inherent tastes and wishes."

The school days over, he turned his attention to astronomy; but finding that it could not yield a support for many years, he looked for a temporary substitute to civil engineering as a profession whose base was mathematical, while special circumstances led him later to the practice of architecture, so that it was not until he was thirty that he found himself free to return to the chosen work of his life.

In 1864, in company with his brother, John W. Langley, now Professor of Chemistry at the University of Michigan, he visited Europe, and took every opportunity of visiting observatories and meeting astronomers, although the journey was made more for recreation than for study.

After an absence of over a year, he returned to the United States, and during the summer of 1865 he entered the Harvard College Observatory, then under the directorship of Joseph Winlock, as an assistant.

His stay at Cambridge was of short duration, for, on the recommendation of Professor Winlock, he was appointed assistant professor of mathematics in the U. S. Navy, and assigned to duty at the Naval Academy, in Annapolis.

Prior to the war, a small observatory had been built in Annapolis by Professor William Chauvenet, but the subsequent transfer of the academy to Newport, R. I., had prevented any work of importance being undertaken, and the instruments were practically unused. Professor Langley's first duties consisted in remounting them and placing the observatory in working order.

In 1867, he was invited to the charge of the Allegheny Observatory, near Pittsburg, and situated on one of the high hills above the Ohio River.

The endowment of the chair only provided for the observer's salary, while beyond the observatory building and a mounted equatorial of thirteen inches aperture, there was no equipment, so that a definite income to provide the means for research was one of the first necessities to be obtained. This income he himself acquired for the observatory by introducing the then novel system of time service for regulating the public time of Pittsburg and of numerous private offices, also furnishing standard time for the entire railway system centering in Pittsburg. The beats of the standard clock of the observatory were daily sent out automatically by electricity over the telegraph lines from New York and Philadelphia, west as far as Cincinnati and Chicago, north to Lake Erie, and south to Washington. This system of time is still in full operation, and has always maintained a high reputation for accuracy.

Indeed, it is not too much to say that the time service, now so universal in the United States, was inaugurated on its present practical standing by Professor Langley. Not that time had not been occasionally communicated to the public by other observatories, such as the Dudley Observatory, in Albany, N. Y., by Dr. Benjamin A. Gould, but that the extended, regular and official connection with railroads, cities, and the public generally, which has since become common throughout the country, was originated as a system at the Allegheny Observatory in 1869.

In 1870 it became possible for him to turn his attention to original investigation, and since then, by a brilliant series of valuable researches in the domain of solar physics, Professor Langley has achieved a reputation that has carried his name beyond our own shores.

One of his earliest papers, "On the Minute Structure of the Solar Photosphere,"* contains the results of two years' work, and includes his discovery, which has since been confirmed by other authorities, that four-fifths of the sun's light comes from less than one-fifth of its surface. One of the most detailed representations of a sun spot which had been published up to that time accompanied this paper. Edward S. Holden, president of the University of California, says: "This paper is fundamental. It treats of a subject of which little had been accurately known, and it leaves this subject in a satisfactory and settled condition."

"Studies of the External Aspect of the Sun,"* published soon after, contained his well-known engraving of the "typical sun spot," which has received the very highest praises from competent judges, and which has been copied by nearly every author on the subject. It was executed for the purpose of giving material for passing judgment on the current theories of sun spots, and had undoubted influence in determining the present belief that the surface of the sun was essentially gaseous or cloudlike.

The existence of a remarkable thermochroic action in the solar atmosphere, such that the vibrations of great wave-length are less absorbed than the visible and ultra-violet, was the subject of a series of papers published in the *Comptes Rendus*.† In these he also showed that no such difference between the polar and equatorial radiation existed as had been asserted by Secchi.

It followed from the first of these facts that sunlight before absorption contains immensely more blue than we habitually see, and that what we call "white" light is really the product of a selective process in the sun's and earth's atmospheres which has sifted out most of the blue before it reaches us, so that the light of common day is but the dregs of what originally started from the sun.

A study of the influence of sun spots on terrestrial climates was the investigation which he next took up. In a paper which he contributed to the *Monthly Notices of the Royal Astronomical Society*,‡ he describes new methods of determining whether sun spots directly affect our climates or not. As a mere interruption of a given quantity of solar heat, he shows that their total effect on terrestrial climates cannot alter the mean temperature of the earth as much as one degree Fahrenheit. Whether they are indices of some remote action having an influence upon the climate, he does not undertake to say.

In October, 1878, he announced§ his discovery of the duplicity of the "great A" group of the solar spectrum. At the same time he published his paper "On the Temperature of the Sun," in which he gives the results of comparison of the heat and light of the sun with that of the molten steel in the Bessemer converter. The temperature of the sun was then believed by leading men of science to be only about 1,500° C., and Langley furnished proof that it was very much higher than physicists, misled by Dulong and Petit's law, had placed it. That this law was here thoroughly unreliable was demonstrated—a statement which is now fully conceded.

S. P. Langley

PRESIDENT OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

More delicate methods were needed for measuring the radiant energy of the sun, of which he believed two-thirds unexplored for want of proper apparatus, since the thermopile, the most delicate instrument science then possessed for this work, was insufficient for these new investigations, and so he devoted the year 1880 to experiments for the construction of a new instrument for analyzing and measuring this and like forms of energy. This instrument, which he called the bolometer, acts by means of a double system of extremely thin platinum strips, through which a current is made to pass. A sensitive galvanometer connected with both systems keeps its needle steady when the currents are equal. If one system is exposed to heat radiations while the other is protected from them, the temperature of the first is raised, its electric resistance is increased, and the battery currents through the two systems and the galvanometer no longer balance. The galvanometer needle then moves, and the amount of this motion measures the amount of heat disturbance. The sensitiveness of the instrument is far greater than that of the most delicate thermopile, and its constancy specially fits it for its work.*

His first research with this new instrument showed experimentally that the maximum of heat in the normal spectrum was in the orange, and subsequently that the amount of heat which the earth receives from the sun had been greatly underestimated, on account of the previous inability to measure the solar heat in sufficiently small portions of the spectrum. Improved methods for the determination of the "solar constant," that is, the amount of heat received from the sun, were pointed out.

In several memoirs† presented to the French Academy of Sciences he likewise described the leading facts in regard to the distribution of energy in the normal spectrum from the sun, and the distribution of this solar energy before absorption by the earth's atmosphere.

Professor Langley had accomplished so much of value bearing on the science of terrestrial meteorology, that in 1881 he was invited to organize and take charge of an expedition sent out under the joint auspices of the Allegheny Observatory and the United States Signal Service to the Sierra Nevadas of Southern California, for the purpose of applying his improved methods under the most favorable conditions. Mount Whitney, some 15,000 feet high, was chosen as the point of observation.

The results of his work were extensively published in journals both at home and abroad, but most fully as "Researches in Solar Heat and its Absorption by the Earth's Atmosphere," in "The Professional Papers of the Signal Service, No. 15" (Washington, 1884). It was shown that the nature, as well as the amount, of the absorption of the solar rays had been completely misunderstood, and for the first time the general outlines of the actual facts were given. A map accompanied this memoir, giving newly explored regions, the infra-red solar spectrum, with numerous lines and bands, hitherto unknown, and, what was wholly new, with their places fixed upon the normal or wave-length scale by direct observation.

If these statements do not convey to the reader a clear idea of the general scope of the work, we may summarize it otherwise as an investigation of the till now nearly unknown major portion of that energy on which all organic life depends. This, it is to be understood, is the real and practical purport.

Finally, the value of the solar constant, fixed by Pouillet at 1·76 calories, was raised to 3 calories.

In October, 1883, he read a paper‡ before the National Academy of Sciences on the "Experimental Determination of Wave Lengths on the Invisible Prismatic Spectrum," in which he fixes the wave lengths of solar heat throughout the whole extent of the spectrum, previous information having restricted our knowledge to the visible portion only.

During the same year he showed,§ both from theoretical considerations and by experiments, that the absorption of the solar rays by the earth's atmosphere is at least double what it has commonly been supposed to be.

Contemporaneous work was not neglected by these researches to which we have previously alluded, for Professor Langley participated in the expedition sent out by the United States Coast Survey to observe the total eclipse of 1869. On this occasion he was stationed at Oakland, Ky. In 1870 he was sent to Xeres, Spain, on similar work, and there determined the polariza-

* *American Journal of Science*, February, 1874

* *Journal of the Franklin Institute*, August and September, 1874.
† March 22, 29 and September 8, 1875.
‡ November, 1876.
§ *Proceedings the American Academy*, October, 1878.

* See "The Bolometer and Radiant Energy," *Proceedings of the American Academy*, January, 1881; "The Bolometer," *Proceedings of the American Meteorological Society*, December, 1880; and "The Actual Balance," *American Journal of Science*, March, 1881.
† *Comptes Rendus*, 21st March and 18th July, 1881.
‡ *American Journal of Science*, March, 1884.
§ "On the Amount of the Atmospheric Absorption," *American Journal of Science*, September, 1884.

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tion of the solar corona to be radial. The total eclipse of 1878 he observed from Pike's Peak, and published his results in the reports of the Washington Observatory.

The transit of Venus in 1874, and again in 1882, also the transit of Mercury in May, 1878, form the subjects of papers published by him on the occasions specified.

His more popular writings include an account* of "Wintering on Etna," where he spent some weeks during the winter of 1878–79, for scientific purposes, living a hermit's life in a hut, three hours' journey above the inhabited zone, and of the modern astro-physical researches in a series of papers called the "New Astronomy," published in the *Century Magazine* at various intervals, beginning in September, 1884.

Professor Langley has visited Europe five times, and his last voyage was made in response to an invitation from the Royal Institution of Great Britain to lecture before that body. His subject was "Sunlight and the Earth's Atmosphere," and was delivered on April 17, 1885. The reception which he received is one of the gratifying evidences of the fact that science knows no country, and that genius is accorded its recognition irrespective of nationality.

A further token of this feeling was manifested during the present year by his receipt from the Royal Society of Great Britain of the gold and silver medals from the bequest of Count Rumford. Professor Langley also received, in 1887, the gold and silver medals from the Rumford fund, administered by the American Academy of Arts and Sciences. The two distinct foundations of Count Rumford were thus independently represented. In 1885 he was awarded the first "Henry Draper gold medal" by the National Academy of Sciences, for his work in astronomical physics.

He received the degree of LL.D. from the University of Wisconsin in 1882, and during the same year that of Ph.D. from the Stevens Institute of Technology. In 1883 the University of Michigan conferred upon him the degree of LL.D., and in 1887 he received a similar honor from Harvard University at its bicentennial celebration. In January, 1887, in addition to his duties at the Allegheny Observatory, he accepted the office of assistant secretary of the Smithsonian Institution in Washington.

Professor Langley is a member of the following societies: American Philosophical Society (April 16, 1875); the National Academy of Sciences (April 19, 1876); associate fellow of the American Academy of Arts and Sciences (February 14, 1883); and abroad, of the Astronomische Gesellschaft (September 14, 1871); honorary member of La Societe de Physique et d'Histoire Naturelle de Geneve (March 20, 1879); corresponding member of the British Association for the Advancement of Science (November 28, 1882); associate of the Royal Astronomical Society (December 14, 1883); and honorary member of the Manchester Literary and Philosophical Society (April 19, 1887).

Prof. Langley was elected a member of the American Association for the Advancement of Science in 1869, and was advanced to the grade of fellow in 1874. He was elected secretary of the section of mathematics and physics in 1875, and presided over this section in 1879, where he delivered his retiring address on "The Progress of Solar Physics." At the Buffalo meeting of this association, held in 1886, he was elected president, and therefore presided at the great meeting held at Columbia College, in New York, this year.

New Fast Boats.

The large steel paddle steamer Empress, built to the order of the London, Chatham, and Dover Railway Company, for their service in the English Channel, by the Fairfield Shipbuilding and Engineering Company, Limited, was lately run over the measured mile at Skelmorlie, on the Firth of Clyde. Notwithstanding the high head wind that was blowing and the heavy sea that was running at the time, the vessel attained a speed of 21·3 knots (over 24½ miles) per hour. The vessel measures 325 ft. by 34 ft. 9 in. by 22 ft. to upper deck, and is divided into eight water-tight compartments. She has a gross register of 1,200 tons, and is similar in design to the Victoria, which was built in the same yard last year. There is a rudder at each end to facilitate the movements of the vessel in entering and leaving harbors. The vessel is supplied with a set of compound diagonal direct-acting engines, and the boilers, which are constructed of steel, are adapted for a working pressure of 110 lb. per square inch. She is fitted with an electric light installation, and is otherwise most completely equipped.

A successful trial trip was recently made on the Clyde by the new steel screw steamer Victoria, the largest and latest addition made to the great fleet of the Peninsular and Oriental Steam Navigation Company. This is a vessel of 6,267 tons gross register. She measures 465 ft. 9 in. (on load water line) by 52 ft. by 37 ft., and is fitted with triple expansion engines of 7,000 horse power indicated, the cylinders being 40 in., 60 in., and 100 in. in diameter respectively, and the length of piston stroke being 6 ft. She has accommodation for 154 first-class saloon passengers, 156 second-class, and 460 third-class passengers. All the fittings, mechanical appliances, and equipment generally are in keeping with the magnificent character of the steamer. On her trial over the measured mile at Skelmorlie the Victoria attained a speed of 17·4 knots, or nearly 20 miles per hour. This vessel makes up a total of about 100,000 tons of new shipping built by Messrs. Caird & Co. during the past fifteen years for the Peninsular and Oriental Company.

* *Atlantic Monthly*, July, 1890.

PNEUMATIC GUN CARRIAGE AT SANDY HOOK.

(*Continued from first page.*)

nished with a lever on its collar, and this lever instantly responds to the shock of recoil and automatically holds the gun in its vise-like grip, and then, when it is wanted in battery or at the rear buffer, in order to receive its new charge, releases it instantly. To the cross transoms of the slide the running cylinders are attached, furnished with pistons having rods leading to the forward transom of the brackets of the sliding carriage on which the gun rests.

There is a slot motion to the attachment of the collar of the piston rod to the carriage, in order that there shall be free play after firing in the strain on the piston rod in the box at the end of the piston head. Supply and exhaust pipes having reversing valves are furnished the running cylinders, in order to supply compressed air at any pressure. By an admirable arrangement, any amount of air pressure may be left at the rear end of the cylinder after firing, which, as will readily be seen, may be utilized in picking up the recoil, and, by means of the clutch lever, instantly forcing the gun back in battery. No tackle or winch or chain gear is required in training. At the rear end of the carriage is a pair of oscillating cylinders arranged horizontally and affixed to a worm geared in a worm wheel having a pinion geared in a cogged wheel, so arranged that any movement, up or down or lateral, will serve to work the piece in any direction. There is no center of axis or movement of these oscillating cylinders, because of the nice arrangement of the parts, and so there is no occasion for slide valves for a reverse motion; double pairs of supply pipes, which lead to the cylinder bases on either side of the running support, doing this work.

A smart press upon the lever, let it be to one side or to the other, and the training engine moves the gun in response. A cylinder furnishes the power for elevating or depressing the piece. This cylinder is of the upright description, and has enough draught to give whatever air pressure is required. At the breech of the gun, and on either side of it, there are racked standards fitted with a working slot, with a compress or screw surrounding a racked die, and, when the screw lever is touched, the breech of the gun, ponderous as it is, is firmly secured in any position.

The air compressor and the receiver, being wholly underneath the carriage, are out of harm's way; not only, as said before, protected from flying shot, but in no danger from contact with the cartridge car and other heavy moving apparatus. A word should be said here in special commendation of the stand-by recoil check, than which it is hard to conceive of a more ingenious and serviceable contrivance in modern gun gear. The best work of man's hand is but imperfection, and the wise mechanician, knowing this, invariably places a safeguard of reserve in attendance upon even the most cunningly contrived device. And so it is that the Pownall type of pneumatic gun carriage has connected with it this stand-by recoil check, so that, should mishap befall the compressed air machinery or pipes, in battle, the turn of a lever and clutch brings this piece of mechanism quickly into play, and it easily takes the place of the defective recoil check. The reserve check is not fitted with cogged gearing like its prototype, being of still simpler construction. It keeps its parts smooth by attrition, running with the other apparatus, though taking no part in the work of the carriage save, as said before, in case of emergency.

The pneumatic gun carriage shown in the cut stands upon masonry, this being the form of base always constructed in land works for heavy gun carriages. Aboard ship, however, the modern gun deck, barbette tower, or turret, can readily be given sufficient stability for its use. Indeed, the pneumatic gun is especially adapted for sea service, because, receiving and dispelling the shock of recoil wholly within itself, it requires no roadway, comparatively little sea room, and is never cast loose at the end of a line, as was the case with the old style guns. These were so light that when one of them carried away its line and rolled from side to side of the ship, if she were laboring in the sea, it was dangerous to life and limb until caught and lashed, but in no wise threatened the stability of the ship; while the heaviest guns of to-day, should they break loose and go crashing to leeward at the critical moment when the lee guards were under, might even endanger the ship. As was shown in a recent number of the SCIENTIFIC AMERICAN, the hydraulic gun carriage has similar advantages in this respect and in others. Indeed, when one studies the relative merits of these two admirable mechanisms, to wit, the pneumatic and hydraulic gun carriages, it is not difficult to understand why authorities differ so widely as to which is the most effective type.

Much has been alleged as to the uncertainty of water or other liquids to perform the function allotted to them in the cylinders of the hydraulic gun; yet, while it is true that water cannot be thus used with safety during a period of low thermometer, and that spirits of wine, alcohol, and the like in the presence of oil and dust are apt to cloy and clog, it may also be said that machinery for compressing air does not always work smoothly, some parts of it, unless great care be taken, being peculiarly liable to mishap. The Advisory Board of Naval Officers agreed with the Ordnance Committee that the hydraulic carriage was to be preferred for the new cruisers, after a careful and comprehensive examination of both types, while, at the same time, a board similarly made up of officers of the Royal Navy decided in favor of the pneumatic gun carriages for two new ships for the British navy. The type of ship in the two cases was, it is true, quite different, yet the fact remains that the two boards summed up merits and effects quite differently, and, with what might be called the same premises, arrived at conclusions widely separated the one from the other. It must, however, be regarded as a fortunate circumstance that both these, which, as said before, are the principal types, are having a thorough trial under circumstances quite similar to those for which they are designed, because these continual trials will bring out the merits and defects with emphasis, and hence lead to perfecting either the one or the other, or, perhaps, as is most likely and most desirable, both.

Reading without Eyes.

W. H. Murray, a colporteur of the National Bible Society of Scotland, has devised a system of raised characters by which the blind are enabled to read. Says the *Missionary Herald:* We have recently received from Miss C. F. Gordon Cumming, the well-known traveler, an interesting account of this effort to reach a large and suffering class in China. It is estimated that there are over 500,000 blind persons in China. Miss Cumming reports that Mr. Murray began life as a working sawmiller in the south of Scotland; but, having by an accident lost one arm, he became a colporteur in Glasgow, and subsequently went to Pekin. His pity having been aroused for the innumerable blind whom he met everywhere, he has given every spare moment for eight years to the study of a system by which they might be enabled to read. In place of the four thousand characters in ordinary use among the Chinese, he uses embossed dots representing some four hundred and twenty sounds; and his first experiment with a blind beggar from the streets, who was enabled to read fluently within six weeks, showed that the system was practicable. A school was opened at Pekin, and blind boys learned to read with great accuracy and rapidity—indeed, very much more speedily than their companions who had eyesight could learn to read the ordinary Chinese characters.

Progress of English Marine Engineering.

The steamship Ohio, an American built vessel of 3,325 tons, belonging to the International Navigation Co., has lately been repaired in respect to her machinery by James Houden & Co., Glasgow. Her original engines and boilers, 2,100 h. p., have been removed and new ones of equal power put in. The new engines are of the triple expansion type, with three cylinders, 31, 46, and 72 in. diameter, 51 in. stroke. The trial of the new mechanism lately took place, and the results were quite remarkable. The mean indicated h. p. was 2,124, consumption of coal 1·23 lb. per indicated h. p., speed 14·12 knots, or about 16½ miles per hour. The new machinery occupies much less space than the old, thus giving more room for cargo, besides increasing the speed and lessening the consumption of fuel.

We think it doubtful whether there is any concern in this country at present able to engine a ship like the above, and warrant the economies mentioned.

Aluminum Steel.

The *Iron Trade Review*, of Cleveland, says: Some important and very satisfactory experiments have been made at the Cleveland Rolling Mill Company's works during the last two weeks in treating Siemens-Martin steel with small percentages of aluminum manufactured by the Cowles Electric Smelting and Aluminum Company, of this city. The result of the work proved conclusively that a small quantity of aluminum freed the steel from blow-holes and increased the tensile strength somewhat without increasing the elongation, besides adding very materially to the fluidity of the bath, thereby producing much sharper castings. It has not yet been determined how small percentages of aluminum are necessary to secure the required products, but from one-tenth to one-twentieth of one per cent gave satisfactory results. The castings made showed a tensile strength as high as 140,000 pounds to the square inch. The alloy was applied in the form of broken ferro-aluminum.

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The Preservation of Wood.

The durability of wood—that is, its power of resisting the destructive influences of wind and weather—varies greatly, and depends as much upon the particular kind of wood and the influences to which it is exposed as upon the origin of the wood (timber), its age at the time of felling, and other conditions. Beech wood and oak placed permanently under water may last for centuries. Alder wood lasts only a short time when in a dry situation; but when kept under water, it is a very lasting and substantial wood. Taking into consideration the different kinds and varying properties of wood, and the different uses to which it is applied, we have to consider, as regards its durability, the following particulars: 1. Whether it is more liable to decay by exposure to open air or when placed in damp situations. 2. Whether it is, when left dry, more or less attacked by the ravages of insects which while in a state of larvæ live in and on wood. Pure woody fiber by itself is only very slightly affected by the destructive influences of wind and weather. When we observe that wood decays, that decay arises from the presence of substances in the wood which are foreign to the woody fiber, but are present in the juices of the wood while growing, and consist chiefly of albuminous matter, which when beginning to decay also causes the destruction of the other constituents of the wood; but these changes occur in various kinds of wood only after a shorter or longer lapse of time. Indeed, wood may in some instances last for several centuries and remain thoroughly sound. Thus, the roof of Westminster Hall was built about 1090.

Since resinous wood resists the action of damp and moisture for a long period, it generally lasts a considerable time. Next in respect of durability follow such kinds of wood as are very hard and compact, and contain at the same time some substance which—like tannic acid—to some extent counteracts decay. The behavior of the several woods under water differs greatly. Some woods are after a time converted into a pulpy mass. Other kinds of wood, again, undergo no change at all while under water—as, for instance, oak, alder, and fir. Insects chiefly attack dry wood only. Splint wood is more liable to such attack than hard wood; while splint of oak wood is rather readily attacked by insects, the hard wood (inner or fully developed wood) is seldom so affected. Elm, aspen, and all resinous woods are very seldom attacked by insects. Young wood, which is full of sap and left with the bark on, soon becomes quite worm-eaten, especially so the alder, birch, willow, and beech. The longer or shorter duration of wood depends more or less upon the following: *a*. The conditions of growth. Wood from cold climates is generally more durable than that grown in warm climates. A poor soil produces as a rule a more durable and more compact wood than does a soil rich in humus, and therefore containing also much moisture. *b*. The conditions in which the wood is placed greatly influence its duration. The warmer and moister the climate, the more rapidly decomposition sets in; while a dry, cold climate materially aids the preservation of wood. *c*. The time of felling is of importance. Wood cut down in winter is considered more durable than that felled in summer. In many countries the forest laws enjoin the felling of trees only between November 15 and February 15. Wood employed for building, and not exposed to heat or moisture, is not likely to suffer from the ravages of insects; but if it is placed so that no draughts of fresh air can reach it, to prevent accumulation of products of decomposition, decay soon sets in, and the decaying albuminous substances acting upon the fiber cause it to lose its tenacity and become a friable mass. Under the influence of moisture, fungi are developed upon the surface of the wood. These fungi are severally known as the "house fungi" (Thelephora domestica and Boletus destructor) and the clinging fungus (Merulius vestator). They spread over the wood in a manner very similar to the growth of common fungi on soil. Their growth is greatly aided by moisture and by exclusion of light and fresh air. A chemical means of preventing such growths is found in the application to the wood of acetate of oxide of iron, the acetate being prepared from wood vinegar. Wood is often more injuriously affected when exposed to sea water, when it is attacked by a peculiar kind of insect known as the bore worm (Teredo navalis). This insect is armed with a horned beak capable of piercing the hardest wood to a depth of about a foot. These insects originally belonged to and abound in great numbers in the seas under the tropical clime; but the Teredo navalis is met with on the coasts of Holland and England.—*X., the Garden.*

EXPERIMENTS WITH THE "SCIENTIFIC TOP."

The engraving represents an attachment to the "scientific top," by means of which the beautiful and instructive experiments of König may be readily repeated. The part of the apparatus carried by the top consists of two pieces of ordinary silvered glass (looking-glass), 2½ by 5 inches, secured to opposite sides of a light wooden frame of the same size, and ¾ inch thick, by means of strips of stout black paper attached to the frame and to the edges of the glasses. The upper and lower edges of the wooden frame are bored at the center to receive the rod inserted in the bore of the top spindle. The frame fits the rod loosely, and is revolved by frictional contact with the rod and the upper end of the top spindle. This arrangement allows the mirror to revolve at a comparatively low rate of speed, the resistance of the air causing the mirror frame to slip on the rod.

Fig. 1.—TOP WITH REVOLVING MIRRORS—KÖNIG'S MANOMETRIC FLAMES.

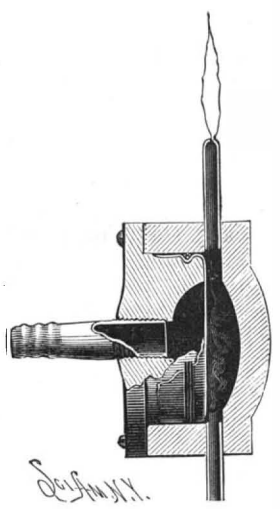

Fig. 2.—SECTION OF DIAPHRAGM CELL.

It is necessary thus to provide for the slow rotation of the mirrors, as the flame points would be blended into a continuous band of light by the persistence of vision were the mirrors allowed to revolve as rapidly as the top.

The device for producing the variable flame is shown in perspective in Fig. 1 and in section in Fig. 2. It consists of a cell formed of two parts, one inserted in the other, and provided with an air chamber, covered by a diaphragm of very thin soft rubber, a gas pipe entering the lower side of the cell at one side of the diaphragm, and a fine gas burner inserted in the cell upon the same side of the diaphragm. A mouthpiece communicates with the air chamber of the cell through a flexible tube, and the gas pipe leading to the cell is connected with the house supply. The gas burner is provided with a narrow shade, which shields the eye of the observer from the direct light of the flame.

The top having been set in motion, the mirror is applied and sounds are uttered in the mouthpiece. By viewing the reflection of the flame in the revolving mirror, it will appear as if formed of a regular series of pointed jets, the persistence of the successive images formed on the retina causing them to appear as if produced simultaneously.

The vibrations of the diaphragm due to the sound waves impinging upon it cause the gas to be pushed out of the burner in little puffs, which are not very noticeable when the flame is observed directly, but which are clearly brought out when examined by the revolving mirror.

By employing a double mouthpiece, two sets of flame points of different lengths alternating with each other may be shown. Each vowel sound yields a characteristic series of flame points. A whistle will yield very fine points, while a very low bass note will produce scarcely more than a single point for each half revolution of the mirror.

The traveling top, shown in Fig. 3, exhibits in a striking way the persistence with which a rapidly revolving body maintains its plane of rotation. The top has a spindle, which is reduced in diameter at its lower end, and provided with a sleeve nicely fitted to the small part of the spindle. In a slot in the lower end of the sleeve is pivoted a small sheave, which is adapted to rest upon and run along a string. The top is set in motion by a string in the usual way, the small sheave being placed astride a string at the start. The string may lie loosely on the table at the start, and as soon as the top is spun the string may be taken up by its ends, lifting the top from the table, when the top may be allowed to run along the string from one end to the other.

By swinging the string sidewise, the top will be made to change its position, but it cannot easily be made to change its plane of rotation. G. M. H.

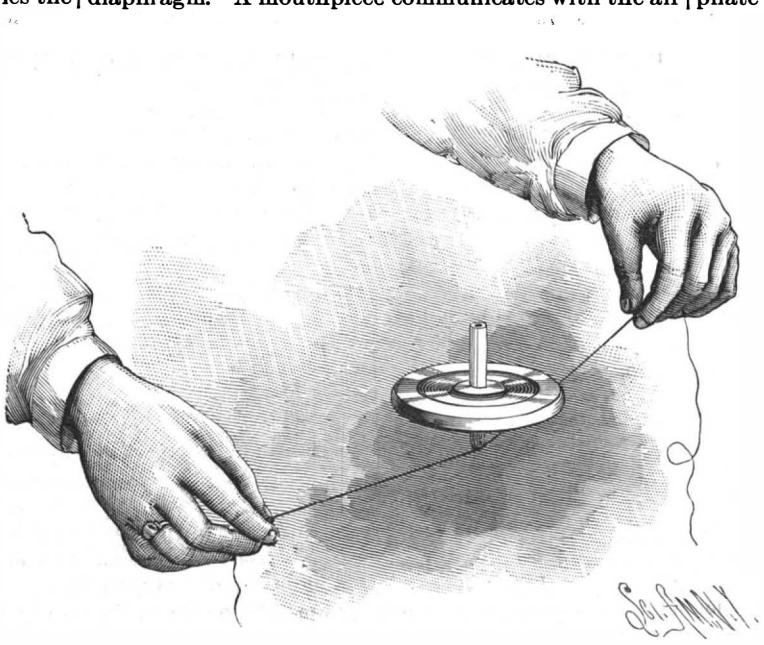

Fig. 3.—TRAVELING TOP.

Electric Phosphorescence.

At a recent meeting of the Royal Society, Mr. W. Crookes, the well known physicist, exhibited a series of tubes in which a vacuum had been formed, and which contained precious stones, minerals, and rare earths rendered luminous or phosphorescent by means of an induction coil.

The coil used contained 57 miles of secondary wire, and was capable of giving a 24 inch spark.

One of the tubes contained a large yellow African diamond, weighing 116 carats. Under the electric current the stone was fluorescent. Other Cape diamonds gave a blue light, and some from Brazil gave an orange, yellow, or blue phosphorescence.

Australian diamonds emitted a yellow, blue, or green light; an Indian diamond gave a yellowish light, bordering upon green; rubies gave a red phosphorescence; the topaz was blue, and the sapphire was green. The phosphorescent calcite of Branchville, S. C., which possesses the strange property of becoming luminous (yellow and golden) when heated to white heat, likewise gave a brilliant phosphorescence in the tube.

Mr. Crookes showed likewise a specimen of dolomite from Utah, called "hellfire rock" by the miners, because it emits a strong red light when it is scraped with a knife. This, in the tube, gave a red light.

Dr. Crookes had also a large number of various kinds of minerals. Of these, we shall mention merely the sulphate of yttrium, which gives a yellow light, with discontinuous spectrum, and sulphate of lime, the phosphorescence of which is red, and the spectrum of which consists of three wide bands.—*La Lumiere Electrique.*

Good Prospect for a Swiss Patent Law.

Holland and Switzerland are about the only states in Europe that have no patent laws. It is well known how the first attempt to obtain a popular vote in favor of the patent law for Switzerland failed from being coupled with a vote on the liquor traffic. This was five years ago. Recently, however, the question was again brought before the voters, and this time not accompaniad by other issues. The result was a decided victory for those who are striving to protect inventors. The number of persons who declared for an alteration of law, with a view to such protection, was 190,000; those against numbered 56,000. The first step has thus been taken to place Switzerland on the same footing, as regards patent rights, as most other Continental countries. The federal government is now empowered to enact a law under which patents will be granted for all such inventions which can be represented by models, but chemical inventions will be excluded by special wish of those interested in chemical industries.

A DOG bitten by a rattlesnake in Nebraska, instead of dying developed hydrophobia, and bit fourteen head of cattle, all of which died.

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ENGINEERING INVENTIONS.

A car heater has been patented by Mr. Palmer J. Gurnee, of Rondout, N. Y. It is designed to act as a heat generator, the car being heated through a drum or coil of pipe, while the construction of the generator is such that it is capable of sustaining great shocks, and yet has ample means to retain the fuel in the heater in the event of accident.

A car brake has been patented by Mr. Lawrence J. Zimmermann, of Brooklyn, N. Y. The brake consists of shoes, more or less rectangular in shape, adapted to be positioned opposite the outer peripheral surface of each wheel, to act directly upon the track, making an auxiliary brake, quickly applied and positive in its action.

A relief valve for engine cylinders has been patented by Mr. Walter Vielhaber, of Altoona, Pa. Its construction is such that when water accumulates in the engine cylinder the pressure exerted on the valve causes it to open automatically, while it can also be opened from the cab of the engine by the usual hand lever or rod.

A balanced valve has been patented by Messrs. William A. Short and Eusebe Lalime, of Malone, N. Y. The invention consists of a cage placed in the steam chest, and having a vertical motion, a cylindrical slide valve operating in the cage, the valve being simple in construction and being completely balanced when the engine is reversed.

A foot guard for railway switches, etc., has been patented by Mr. Edward P. Edwards, of Webster City, Iowa. It is made of sheet iron or other material, of different shapes, to fit openings of different widths between the rails, and adapted to be readily fastened in place, so as not to interfere with the working of the car wheels, while protecting the feet of those stepping on the rails.

A safety base for flues has been patented by Mr. Frank Anderson, of Union Springs, Ala. It is designed to prevent the wood surrounding the lower part of the flues in houses from becoming overheated, and consists in a perforated metal casing surrounding the lower part of the flue, and having a central metallic pipe extending upward and built into the brickwork.

A car coupling has been patented by Mr. Philip Riley, of Marion, Iowa. It is designed to allow cars to couple automatically as they come together, or to be coupled by the operation of a hand lever at the side of the car, the coupling being fitted with a brake attachment preventing the withdrawal of the entered coupling link, thereby assuring the dropping of the pin through the link.

A hydraulic lift has been patented by Mr. Thomas Pownall Ford, Jr., of London, England. The invention consists in the employment of means of controlling the inlet and outlet of water to and from the two ends of a cylinder simultaneously and to the same extent, avoiding hissing noise, and, with such valves operating simultaneously, employing a column of water to partially counteract the pressure of water entering through the inlet valve, with other novel features.

AGRICULTURAL INVENTIONS.

A cotton chopper and cultivator has been patented by Mr. Horace N. Sibley, of Midway, La. Its construction is such that the machine may be used as a chopper to remove surplus plants and accurately define the row, and may be subsequently adjusted to operate as a cultivator for the plants as they increase in size.

A spring hoe attachment for cultivators, seed drills, etc., has been patented by Mr. Charles R. Hartman, of Vincennes, Ind. It consists of a locking device to hold the shovel of the implement to which it is attached with the requisite rigidity under ordinary strain while at work, but so as to yield to too great strain, to prevent breakage of the shovel or hoe.

MISCELLANEOUS INVENTIONS.

A belt shifter has been patented by Mr. George H. Lowe, of Middletown, N. Y. It consists of a suitable frame provided with rollers to receive the belt from the pulley, and one or more rollers being adapted, under a novel form of construction, to be tilted for shipping the belt back upon the pulley.

A leather skiving machine has been patented by Messrs. Fritz Engel, of Worms on the Rhine, and Carl Wagner, of Offenbach on the Main, Germany. It is for thinning the edges of leather, and is especially adapted for the use of saddlers, trunk makers, bookbinders, etc., the invention covering various novel details and combinations of parts.

A billiard cue chalker has been patented by Messrs. Samuel Clare and Edward W. Smith, of Winnipeg, Manitoba, Canada. It consists of a spirally slotted tube containing a cylindrical chalk case, with spiral spring, and other novel features, whereby the chalk dust is retained, and the tips are kept round and uniform in shape.

An egg beater has been patented by Mr. La Fayette Wikidal, of Salem, Oregon. This invention covers a novel construction and combination of parts of an egg beater that is designed not only for whipping up eggs, but which may be used for beating up batter and other substances, or for mixing ingredients of any kind used in making cake or bread.

A center board for vessels has been patented by Mr. Thomas R. Brough, of Gananoque, Ontario, Canada. The center board case contains a series of blades arranged to swing on a common pivot, with cam slots in the blades, and other features, whereby the free ends of the blades may be projected from he center board casing as desired.

A lamp filling can has been patented by Mr. John A. Kendall, of Maysville, Mo. This invention relates to that class of oil cans having an air forcing apparatus by which the oil is discharged through a suitably arranged outflow pipe into the lamp by producing an air pressure, the cam being simple in construction and very effective.

A bob sled has been patented by Mr. Joseph P. Kramer, of West Branch, Mich. Its construction is such that there is a slight rocking movement between the runners and the bench, to allow the runners to change position slightly in rising over obstructions in the road without imparting a jolt or jerk to the superstructure.

A standard for logging cars has been patented by Mr. Edmund J. Minnock, of Baker, Texas. It is a pivoted standard connected by links to a lever a short distance from its pivot, which can be readily turned down out of the way when loading, and which when turned up into position will be firmly and securely held.

A copy holder has been patented by Mr. Irvine J. Adair, of Dallas, Texas. It is a novel device intended to hold the paper to be copied almost the same as one would hold a book in reading, all the lines being held the same distance from the eye, and a spring serving to hold the leaf in place when used to copy into a record book.

A thimble skein has been patented by Mr. John E. Young, of America City, Kansas. It is for wooden axles, and has one or more holes through its sides to permit the passage of oil or lubricating material to the wood within to preserve it, and having also near its inner end an internal peripheral groove to receive a packing ring.

A logging sled has been patented by Mr. John Wisdom, of Moose Lake, Minn. It consists of a peculiarly formed runner or shoe, in combination with a cross bar or bolster for supporting the log, and an arrangement of chains for lashing the log to the bolster and for receiving the evener to which the horses are hitched.

A joint for extension handles has been patented by Mr. Charles A. Bartliff, of Memphis, Tenn. It comprises a socket with longitudinal extension and transverse adjustable bands or wires connected at their ends to opposite side edges of the extension, the improvement being more especially intended for use with brooms, brushes, and mops.

Ornamental strips for picture frames form the subject of a patent issued to Mr. Edward Brodhag, of New York City. The strip consists of a solid flexible core or band, as of strip brass, on which is cemented a soft inclosing covering of plush or other soft and fluffy material, this compound strip to be bent as desired, and retaining its shape, for ornamenting purposes.

A grate for stoves and furnaces has been patented by Mr. Pillsbury C. Dolliver, of Augusta, Me. The grate has two oppositely pivoted grate sections, the longitudinal and cross bars of one section being in the same plane and the longitudinal bars of the other section being above its cross bars, one of the sections having support from the other section, in combination with novel operating devices.

A spectacle joint has been patented by Mr. Frederick Scheidig, of New York City. The invention consists in making the temple from a blank formed with oppositely projecting ears adapted to be bent parallel with each other and embrace the eye on the end piece, and with a lug arranged to strike the stop shoulder on the end piece, making a simple, strong, and easily attachable joint.

A galvanic battery has been patented by Mr. Horatio J. Brewer, of New York City. It consists of a porous cup having a flange resting on a shoulder formed in the jar, means for holding the cup and zinc bar in place at the bottom of the jar, and a zinc bar passing through the side of the jar, the invention being designed to prevent evaporation of the liquid and save a considerable amount of zinc.

A combined egg tester and register has been patented by Messrs. Charles J. Mikesh and Homer W. Conant, of Sheldon, Iowa. The object of this invention is to provide a cheap, durable, and convenient device, with the parts so arranged that as the eggs are tested their number will be automatically indicated by a simple mechanism, not liable to become disarranged.

A releasing device for use in connection with horse stables has been patented by Mr. Mortimer M. Shelley, of Brooklyn, N. Y. The invention provides a novel construction and arrangement whereby, in case of fire, all the horses in a given row of stalls may be released at the same time, and will be driven from their stalls by water automatically dashed in their faces from apertures in fixed pipes.

A vehicle top has been patented by Mr. Thomas B. McCurdy, of Lancaster, Texas. Its construction is such that the side curtains may be forced upward to positions beneath the top proper, there being strips to serve as guides upon which the curtain frames slide, and other novel features, the invention being an improvement on a former patented invention of the same inventor.

A door jamb has been patented by Mr. Christian Henricson, of Ashland, Wis. It consists in a facing supported and guided by horizontal rods and pressed forward into contact with the edge of the door by springs, making a door jamb which compensates for the swelling or shrinking of the door and designed to always rest in contact with the edge of the door when the latter is closed.

A saw filing machine has been patented by Mr. John H. Sodee, of Seattle, Washington Ter. The invention consists of an improved form of file and file holder, and improved form of mechanism for cleaning off the burr made in sharpening the saw, with other novel features, the machine being designed for sharpening or filing either circular or gang saws, and requiring but slight adjustment for use for saw gumming.

An apparatus for aerial photography has been patented by Mr. James Fairman, of New York City. Combined with a camera-carrying balloon are guy ropes for steadying it, the suspended camera having a funnel-shaped shield with its apex attached to the suspension link of the camera, and extending down to partly inclose the sides and top of the camera, the device being designed for locating the camera and taking views from a great altitude.

A feed regulator for roller mills and purifiers has been patented by Messrs. John W. Edwards and Chauncey L. Becker, of Waterloo, N. Y. Combined with the hopper are valve straps pivotally connected with the valve, a hinged spring arm and plate being also applied to the hopper, with other novel features, whereby the pressure of the material in the hopper will act upon the valve to automatically regulate the discharge by the feed roll.

An extractor for pulling roots, weeds, etc., has been patented by Mr. Robert L. Shaw, of Franklin, Pa. It consists mainly of two grasping jaws and a stock or handle to which they are connected, the jaws being of novel shape and pivoted together by a strong bolt, and a chain being connected at opposite ends to the handle and the inner end of a fulcrum bar, limiting the extent to which the points of the jaw may be opened.

SCIENTIFIC AMERICAN BUILDING EDITION.

AUGUST NUMBER.

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2. Plate in Colors of a Twelve Hundred Dollar Double House, with plans, specifications, sheet of details, bills of estimate, etc.
3. Page engraving of an Elegant Residence corner Eighth Avenue and Berkeley Street, Brooklyn, N. Y.
4. The new United States Court House and Post Office, Montpelier, Vermont. Half page engraving.
5. Half page engraving showing Competitive Design for Carnegie Free Library, Allegheny City, Pa., Jas. W. McLaughlin, Architect.
6. The National Agricultural Exposition Building at Kansas City. Quarter page engraving.
7. Drawing in perspective, with floor plans, of a Forty-five Hundred Dollar Dwelling.
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Curtis Pressure Regulator and Steam Trap. See p. 253.

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NEW BOOKS AND PUBLICATIONS.

THE CREMATION OF THE DEAD. By Hugo Erichsen. Detroit: D. O. Haynes & Co. Pp. 264. $2.

The sanitary and economical arguments usually adduced in favor of disposing of the mortal remains of human beings by incineration, with a selection of facts and sayings touching the subject from far back in ancient history to the present time, are here brought together in a unique volume. The book is embellished with illustrations of many crematories, and gives with some detail the particulars as to the organization and work of the principal societies formed in recent years to advocate cremation and afford facilities therefor. The author is an ardent advocate of the general introduction of cremation as a means of disposing of the dead instead of by burial, and the volume is a plea to the public, calling for a more active interest in the subject, which, it is conceded, the people must be educated up to before it can become popular.

THE GRAPHICAL STATICS OF MECHANISM. By Gustav Herrman. Translated by A. P. Smith, M.E. Pp. vii, 158. New York: D. Van Nostrand. 1887. Plates.

Starting with the simpler problems of the equilibrium of machines, the graphic method is applied to the treatment of all the ordinary problems of mechanics. To all except those peculiarly conversant with the higher mathematics, much of the advance of the last few years in mechanics are of little avail. But by the system so intelligibly explained and illustrated in this work, these higher problems are attacked by graphic methods, that for accuracy, simplicity, and practical utility leave nothing to be desired. Professor Herr-

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man has won an extensive fame by his researches in this special line. The merit and value of the book depends largely on his original investigations. After the subject of the equilibrium of machines is disposed of, the subject of friction and hurtful resistances occupies much of the space. Rolling, sliding, journal, tooth, and chain friction, usually complicated subjects, are here disposed of by the wonderfully practical methods of Professor Herrman's graphics. Belt gearing and practical examples with some concluding remarks complete the text. The translator's work is well done, and some notes by him add to the clearness of the text. Eight folding sheets of plates are used to illustrate the problems.

PRACTICAL ELECTRIC LIGHTING. By A. Bromley Holmes. London and New York: E. & F. N. Spon. Pp. 183. $1.

This book presents in simple form a good many of the most interesting facts touching the especial department of electrical work to which it is devoted, the final chapters discussing the motive power and the cost of electric lighting.

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Notes & Queries

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Names and Address must accompany all letters, or no attention will be paid thereto. This is for our information, and not for publication.
References to former articles or answers should give date of paper and page or number of question.
Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all, either by letter or in this department, each must take his turn.
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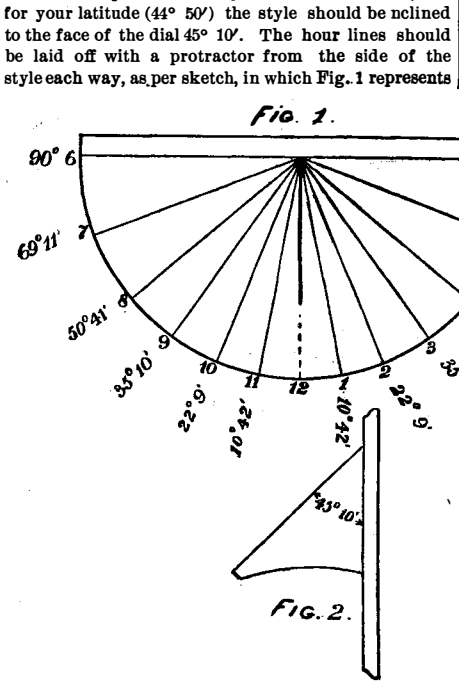
Scientific American Supplements referred to may be had at the office. Price 10 cents each.
Books referred to promptly supplied on receipt of price.
Minerals sent for examination should be distinctly marked or labeled.

(1) F. W. (Vermont) asks (1) the best way to make a sun dial, to fasten on the side of the house. A. The dial must have its plane due east and west, and perfectly vertical by plumb line. The style should correspond with the polar axis of the earth, and for your latitude (44° 50′) the style should be nclined to the face of the dial 45° 10′. The hour lines should be laid off with a protractor from the side of the style each way, as per sketch, in which Fig. 1 represents



a plan and Fig. 2 a section through style. Such a dial keeps only mean time, and you will have to consult almanac as to when the sun is fast and slow. 2. The best cement to mend rubber coats and boots. A. For mending rubber goods, use rubber cement, which can be obtained from the dealers in rubber goods. See SUPPLEMENT, No. 158, for numerous cements.

(2) Carter wishes to know how to free his pond from the little plant called "duckmeat." A. It would be a difficult matter, if not an impossibility, to free the pond entirely from these plants without the addition to the water of some substance that would destroy all plant life. The "duckmeats" are constituted for living in ponds that sometimes dry up, and hence have great vitality, and will revive on the application of moisture after being apparently dried up for some time. They are propagated by lateral buds that form new plants, and hence multiply very rapidly. There is no better method of keeping the plants in subjection than the one that you have used. If you have ducks, give them access to the pond, and they will aid in the work of destruction, since they are very fond of the plant, and this circumstance gives the latter its common name. In the case of a fish pond, the presence of the duckmeats is rather beneficial than otherwise, since they become a depository for the larvæ of insects to an extent almost incredible, and thus afford an abundant supply of food for fish.

(3) D. W. F. desires a good receipt to polish pianos. A. Add to 1 pint of shellac varnish 2 tablespoonfuls of boiled oil; the two to be thoroughly mixed. If you want the work dark, add a little burnt umber; or you can give the work any desired shade by mixing with the shellac the proper pigment in the dry state. Apply the shellac, thus prepared, with a small bunch of rags held between your fingers. In applying it, be careful in getting it on smooth and even, leaving no thick places or blotches. Repeat the process continually until the grain is filled and the work has received sufficient body. Let it stand a few hours to harden, and then rub your work lightly with ground pumice stone and oil, applied with a rag. A very little rubbing is necessary, and this is to be followed by the cleaning of the work with rags as dry as possible. With a piece of muslin wet with alcohol go over the work two or three times for the purpose of killing the oil. Have ready ¼ pound of pure gum shellac dissolved in one pint of alcohol (95 per cent). With this saturate a pad made of soft cotton covered with white muslin, and with this pad go over the work several times.

(4) J. H. D. asks: 1. What was the first railroad built in the United States, and in what year was it built? A. The first American railroad was built in 1825–26, and used for the purpose of transporting granite from the quarries near Quincy, Mass., to tide water. 2. How to clean buckskin riding trousers? A. Make a solution of weak soda and warm water, rub plenty of soft soda into the leather and allow it to soak for two hours and then rub it well until it is quite clean. Afterward rinse thoroughly in a weak solution of warm water, soda and yellow soap. When completely rinsed, dry well and quickly in a rough towel, then pull it about and brush it well. It will never, however, be as soft and good as it was at first.

(5) P. C. desires (1) a good receipt for a black bright varnish for harness. A. Grind ivory black into a quick-drying body varnish. 2. How yolks of eggs can be preserved for tawing purposes. A. Drive the moisture off by evaporating them *in vacuo*, same as the white of egg is prepared. 3. How vegeto-animal court plaster is made? A. The Pharmacopœia gives many receipts for the different varieties.

(6) W. B. P. asks: 1. Are wall papers containing arsenic usually considered deleterious to health? A. They are. 2. How are they supposed to affect or act on the human system? A. Dyspepsia, neuralgia, pains in the bones and joints simulating chronic rheumatism, headache, general debility, etc., are symptoms which attend chronic arsenical poisoning. See Taylor's "Medical Jurisprudence." 3. Are the dark and olive greens usually prepared with arsenic or arsenite of copper? A. Not generally, but occasionally; analysis is always necessary to determine the presence of arsenic. 4. Is the usual test—dissolving the color from the paper with aqua ammonia, and testing with a crystal of nitrate of silver—considered practically correct? A. It is an inferior test.

(7) F. D. H.—The whole amount of wheat produced in the world in 1885, calculated in bushels of 60 pounds, was 1,998,997,635 bushels. The United States wheat crop for three years past has been between 450 and 495 million bushels each year.

(8) B. M. L. asks how type writer ribbons are made, such as are used on the Remington and other such machines. A. Take vaseline of high boiling point, melt it in a water bath or slow fire, and incorporate by constant stirring as much lamp black or powdered drop black as it will take up without becoming granular. If the fat remains in excess, the print is liable to have a greasy outline; if the color is in excess, the print will not be clear. Remove the mixture from the fire, and while it is cooling mix equal parts of petroleum benzine and rectified oil of turpentine, in which dissolve the fatty ink, introduced in small portions, by constant agitation. To apply, wind the ribbon on a piece of cardboard, spread on a table several layers of newspapers, then unwind the ribbon into convenient length, and with a soft brush rub the ink, after agitation, well into the interstices of the ribbon with a stiff tooth brush.

(9) A. D. asks how tracing cloth is made and the composition of the varnish put on its tissue. A. Linen is first provided with a coating of starch and then with an application of benzine and linseed oil. It is finished by being smoothed between polished rollers.

(10) N. D. asks: How is the velocity of the cannon ball at the muzzle of the gun ascertained? A. By an electric apparatus, the ball breaking a circuit at different distances, and thus recording the time of passing through certain spaces. See SCIENTIFIC AMERICAN SUPPLEMENT, No. 177, for description and illustrations.

(11) F. B. desires a receipt to make green paint for Venetian blinds that will stand the heat of the sun without blistering. A. Rub 2 parts of white lead and 1 of verdigris with nut oil or linseed oil varnish, mixed with oil of turpentine, and dilute both colors with ordinary drying oil.

(12) F. M. W. asks: 1. Is a brake block pressing against three feet of the tire of a wagon wheel practically any better than one pressing against two feet? A. There is nothing gained, except there is a difference in wear by using a long brake block. The friction for a given pressure is the same, whether the block is one foot or three feet long. 2. Suppose a 20 foot bar of iron lying on the ground. A lifts one end up three feet, B then goes to other end and raises it level with first end. Which man lifts most, and why? A. The thrust of the bar against its ground bearing makes the lift of B a little heavier at starting to raise the bar.

(13) M. & S. desire a receipt for making papier mache and cellulose. A. There are two modes of making papier mache—either by gluing or pasting different thicknesses of paper together, or by mixing the substance of the paper into a pulp, and then pressing it into shape by moulds. Cellulose is woody fiber, and is the basis of paper.

(14) A. C. L. desires (1) good receipt for making plaster Paris casts, in imitation of bronze. A. See answer to query 1 in SCIENTIFIC AMERICAN of April 9, 1887. 2. Please explain the cause of rock salt throwing off water as it does. A. It is due to the chloride of magnesium, which attracts moisture and drains away.

TO INVENTORS.

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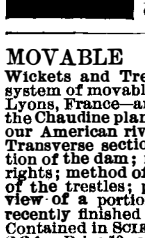

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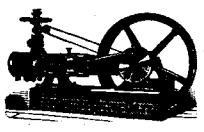
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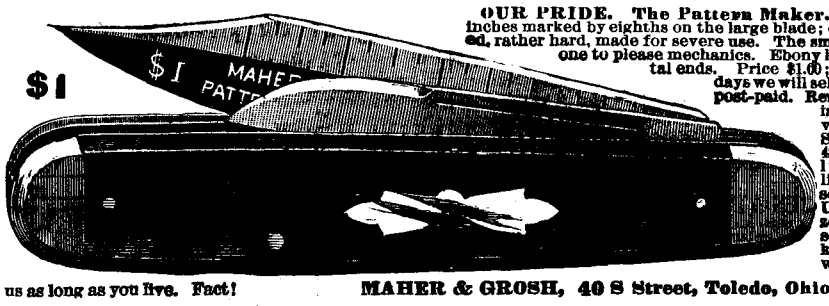

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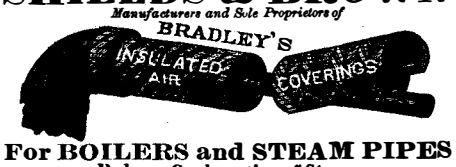

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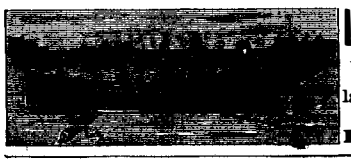

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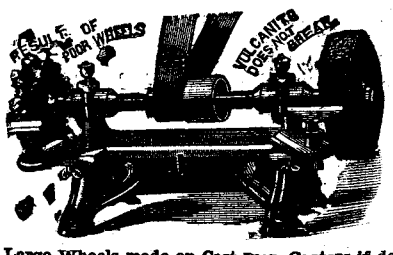

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Proposals for Steel-cast Guns for the Navy.
NAVY DEPARTMENT,
WASHINGTON, D. C., *June* 23, 1887.

Under authority conferred by the act of Congress, approved March 3, 1887, making an appropriation "for the purchase and completion of three steel-cast, rough-bored and turned, six-inch, high-power rifle cannon, of domestic manufacture, one of which shall be of Bessemer steel, one of open-hearth steel, and one of crucible steel," sealed proposals from domestic manufacturers, to furnish the same, will be received at this Department until Tuesday, the second day of August, 1887, at 12 o'clock noon, at which time the proposals will be opened.

Proposals may be made either to furnish three completely finished six-inch, breech-loading, high-power rifle cannon, made from unforged castings, one of Bessemer steel, one of open-hearth steel, and one of crucible steel, or three unforged, rough-bored and turned castings for such cannon, of the same material, respectively, to be finished by the Department in accordance with the bidder's design.

* * * * * * * *

No gun or casting for a gun will be paid for until the gun "shall have been completed and have successfully stood the statutory test required by the act of July twenty-sixth, eighteen hundred and eighty-six," entitled "an act making appropriations for the naval service for the fiscal year ending June thirtieth, eighteen hundred and eighty-seven, and for other purposes." [For statement of requirements of said tests, and of other conditions to be observed, reference is made to "specifications" which can be had upon application to the Department.]

Proposals may be made for one or more guns or for one or more castings as aforesaid, * * * [but must be made separately for each gun, or casting for a gun, and upon forms prepared by the Department.]

Each successful bidder will be required to execute, within fifteen days after notice of award, a formal contract in accordance with his proposal, and to furnish a bond, with satisfactory sureties, in a penal sum equal to fifteen per cent. of the amount of his bid, conditioned for the faithful performance of such contract.

Copies of the specifications, with blank forms of proposals, and all additional information desired, can be obtained on application to the Bureau of Ordnance, Navy Department.

All proposals must be in duplicate, inclosed in envelopes marked "Proposals for Steel-cast Cannon," and addressed to the Secretary of the Navy, Navy Department, Washington, D. C.

The right is reserved to waive defects in form and to reject any or all bids.

WILLIAM C. WHITNEY,
Secretary of the Navy.

NAVY DEPARTMENT,
WASHINGTON, D. C., *July* 20, 1887.

In order to give more time to domestic manufacturers to consider the matter, the period limited for the reception of proposals for steel cast guns is hereby extended, and such proposals will be received, under the foregoing advertisement, as modified, until Tuesday, September 20, 1887, at 12 o'clock noon, at which time the proposals will be opened.

WILLIAM C. WHITNEY,
Secretary of the Navy.

Proposals for three Overhead Travelling Cranes complete, three Supports for such Cranes, and one Iron Frame for a Building.
NAVY DEPARTMENT,
WASHINGTON, D. C., *July* 23, 1887.

Sealed proposals will be received at the Navy Department, Washington, D. C., until 12 o'clock noon, on Thursday, the 15th day of September, 1887, at which time and place they will be opened in the presence of bidders, for furnishing the necessary material and laber and constructing, delivering and erecting the iron work for the supports of three overhead travelling cranes, the frame of one building, and three overhead travelling cranes complete, including attachments pertaining thereto, for the Ordnance Gun-shops at the Navy Yard, Washington, D. C., in accordance with plans which may be seen, and specifications, copies of which, together with all other information essential to bidders, may be obtained at the Office of the Civil Engineer at said Navy Yard. Proposals must be made in accordance with forms which will also be furnished on application to that Office.

Proposals must be made in duplicate and inclosed in envelopes marked "Proposals for Overhead Travelling Cranes complete, for Iron Supports for such Cranes, and Iron Frame for a Building," and addressed to the Secretary of the Navy, Navy Department, Washington, D. C.

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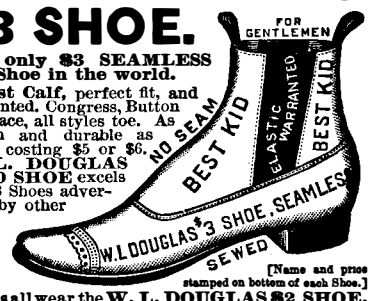

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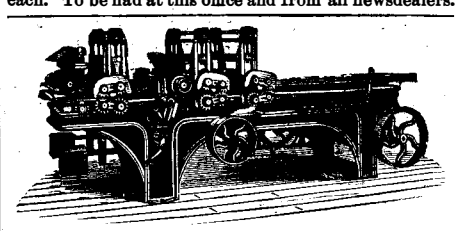

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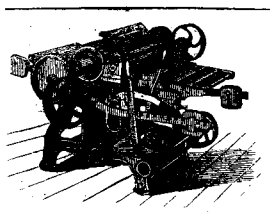

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